University of Debrecen
Faculty of Science and Technology
Institute of Biology and Ecology

BIOLOGY MSC PROGRAM

2024

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DEAN`S WELCOME

Welcome to the Faculty of Science and Technology!

This is an exciting time for you, and I encourage you to take advantage of all that the Faculty of Science and Technology UD offers you during your bachelor’s or master's studies. I hope that your time here will be both academically productive and personally rewarding

Being a regional centre for research, development and innovation, our Faculty has always regarded training highly qualified professionals as a priority. Since the establishment of the Faculty in 1949, we have traditionally been teaching and working in all aspects of Science and have been preparing students for the challenges of teaching. Our internationally renowned research teams guarantee that all students gain a high quality of expertise and knowledge. Students can also take part in research and development work, guided by professors with vast international experience.

While proud of our traditions, we seek continuous improvement, keeping in tune with the challenges of the modern age. To meet our region’s demand for professionals, we offer engineering courses with a strong scientific basis, thus expanding our training spectrum in the field of technology. Recently, we successfully re-introduced dual training programmes in our constantly evolving engineering courses.

We are committed to providing our students with valuable knowledge and professional work experience, so that they can enter the job market with competitive degrees. To ensure this, we maintain a close relationship with the most important companies in our extended region. The basis for our network of industrial relationships are in our off-site departments at various different companies, through which market participants - future employers - are also included in the development and training of our students.

Prof. dr. Ferenc Kun

Dean

UNIVERSITY OF DEBRECEN

Date of foundation: 1912 Hungarian Royal University of Sciences, 2000 University of Debrecen

Legal predecessors: Debrecen University of Agricultural Sciences; Debrecen Medical University; Wargha István College of Education, Hajdúböszörmény; Kossuth Lajos University of Arts and Sciences

Number of Faculties at the University of Debrecen: 14

Faculty of Agricultural and Food Sciences and Environmental Management

Faculty of Child and Special Needs Education

Faculty of Dentistry

Faculty of Economics and Business

Faculty of Engineering

Faculty of Health

Faculty of Humanities

Faculty of Informatics

Faculty of Law

Faculty of Medicine

Faculty of Music

Faculty of Pharmacy

Faculty of Public Health

Faculty of Science and Technology

Number of students at the University of Debrecen: 30,899

Full time teachers of the University of Debrecen: 1,597

210 full university professors and 1,262 lecturers with a PhD.

FACULTY OF SCIENCE AND TECHNOLOGY

The Faculty of Science and Technology is currently one of the largest faculties of the University of Debrecen with about 3000 students and more than 200 staff members. The Faculty has got 6 institutes: Institute of Biology and Ecology, Institute of Biotechnology, Institute of Chemistry, Institute of Earth Sciences, Institute of Physics and Institute of Mathematics. The Faculty has a very wide scope of education dominated by science and technology (11 Bachelor programs and 13 Master programs), additionally it has a significant variety of teachers' training programs. Our teaching activities are based on a strong academic and industrial background, where highly qualified teachers with a scientific degree involve student in research and development projects as part of their curriculum. We are proud of our scientific excellence and of the application-oriented teaching programs with a strong industrial support. The number of international students of our faculty is continuously growing (currently ~760 students). The attractiveness of our education is indicated by the popularity of the Faculty in terms of incoming Erasmus students, as well.

THE ORGANIZATIONAL STRUCTURE OF THE FACULTY

Dean: Prof. Dr. Ferenc Kun, Full Professor
E-mail: ttkdekan@science.unideb.hu

Vice Dean for Educational Affairs: Prof. Dr. Gábor Kozma, Full Professor
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Vice Dean for Scientific Affairs: Prof. Dr. Sándor Kéki, Full Professor
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Consultant on External Relationships: Prof. Dr. Attila Bérczes, Full Professor
E-mail: berczesa@science.unideb.hu

Consultant on Talent Management Programme: Prof. dr. Tibor Magura, Full Professor
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Dean's Office
Head of Dean's Office: Mrs. Katalin Kozma-Tóth
E-mail: toth.katalin@science.unideb.hu

English Program Officer: Mrs. Alexandra Csatáry
Address: 4032 Egyetem tér 1., Chemistry Building, A/101, E-mail: acsatary@science.unideb.hu

PARTICIPATING DEPARTMENTS OF THE INSTITUTE OF BIOLOGY AND ECOLOGY

Department of Botany (home page: https://biology.unideb.hu/bemutatkozas-novenytani-tanszek)
4032 Debrecen, Egyetem tér 1, Life Sciences Building

Name	Position	E-mail	room
Dr. Márta Hamvas, PhD, habil	Associate professor	hamvas.marta@science.unideb.hu	1.501
Dr. János Kerékgyártó, PhD	Senior researcher	kerekgyarto.janos@science.unideb.hu	1.511
Dr. Csaba Máthé, PhD, habil	Professor	mathe.csaba@science.unideb.hu	1.501
Dr. Viktor Oláh, PhD, habil	Associate professor	olah.viktor@science.unideb.hu	1.504
Dr. Gábor Sramkó, PhD	Assistant professor	sramko.gabor@science.unideb.hu	1.502
Dr. Gyula Surányi, PhD	Assistant professor	suranyi.gyula@science.unideb.hu	1.511

Department of Ecology (home page: http://ecology.science.unideb.hu/)
4032 Debrecen, Egyetem tér 1, Ecology Building

Name	Position	E-mail	room
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Dr. Edina Simon-Kundrát, PhD, habil	Professor	simon.edina@science.unideb.hu	017
Prof. Dr. Péter Török, PhD, habil, DSc	Professor	torok.peter@science.unideb.hu	019
Dr. Roland Horváth, PhD	Associate professor	horvath.roland@science.unideb.hu	003

Department of Evolutionary Zoology and Human Biology (home page: http:// http://zoology.unideb.hu/home/)
4032 Debrecen, Egyetem tér 1, Life Sciences Building

Name	Position	E-mail	room
Prof. Dr. Zoltán Barta, PhD, habil., DSc	Professor, Head of Department	barta.zoltan@science.unideb.hu	1.206
Dr. Miklós Bán, PhD	Assistant professor	ban.miklos@science.unideb.hu	1.203
Dr. Ádám Zoltán Lendvai, PhD, habil.	Associate professor	lendvai.adam@science.unideb.hu	1.207
Dr. Zoltán Németh, PhD	Assistant professor	nemethzoltan@science.unideb.hu	1.201
Dr. Nikoletta Nagy, PhD	Assistant professor	nagy.nikoletta@science.unideb.hu	1.204
Dr. Jácint Tökölyi, PhD, habil.	Associate professor	tokolyi.jacint@science.unideb.hu	1.202

PARTICIPATING DEPARTMENTS OF THE INSTITUTE OF BIOTECHNOLOGY

Department of Biochemical Engineering (home page: https:// https://biotechnologia.unideb.hu/hu/bemutatkozas-biomernoki-tanszek/)
4032 Debrecen, Egyetem tér 1, Chemistry Building

Name	Position	E-mail	room
Dr. Levente Karaffa, PhD, habil, DSc	Professor, Head of Department	karaffa.levente@science.unideb.hu	D-8

Department of Genetics and Applied Microbiology (home page: https://biotechnologia.unideb.hu/)
4032 Debrecen, Egyetem tér 1, Life Sciences Building

Name	Position	E-mail	room
Dr. Ida Miklós, PhD, habil	Associate professor, Head of Department	miklos.ida@science.unideb.hu	2.503
Dr. Zsuzsa Antunovics, PhD	Assistant professor	antunovics.zsuzsa@science.unideb.hu	2.502
Dr. Teréz Barna, PhD	Assistant professor	barna.terez@science.unideb.hu	D-207/208 lab (Chemistry Bld)
Dr. Gyula Batta, PhD	Assistant professor	batta.gyula.ifj@science.unideb.hu	2.501
Dr. Hajnalka Csoma, PhD	Assistant professor	csoma.hajnalka@science.unideb.hu	2.501
Prof., Dr. Mátyás Sipiczki, PhD, habil, DSc	Professor emeritus	lipovy@gmx.com	2022/2023 lab

ACADEMIC CALENDAR

General structure of the academic semester (2 semesters/year):

Study period	1st week	Registration*	1 week
	2nd – 15th week	Teaching period	14 weeks
Exam period	directly after the study period	Exams	7 weeks

*Usually, registration is scheduled for the first week of September in the fall semester, and for the first week of February in the spring semester.

For further information please check the following link:
https://www.edu.unideb.hu/tartalom/downloads/University_Calendars_2024_25/University_calendar_2024-2025-Faculty_of_Science_and_Technology.pdf

THE BIOLOGY MASTER PROGRAM

Information about the Program

Name of MSc Program:	Biology MSc Program
Specialization available:	Biologist, numerical Biologist
Field, branch:	Science
Qualification:	Biologist
Mode of attendance:	Full-time
Faculty, Institute:	Faculty of Science and Technology Institute of Biology and Ecology
Program coordinator:	Prof. dr. Zoltán Barta, professor dr. Zoltán Németh, assistant professor
Duration:	4 semesters
ECTS Credits:	120

Objectives of the MSc program:

The aim of the Biology MSc program is to train professional scientists who have deep insight into biological processes. Relying on strong biological, evolutionary and ecological knowledge, graduates of the program are able to understand complex natural phenomena and to develop applied science-based solutions to problems in their respective fields. We offer two specialisations, one "biologist" provides a general education in the fields of biology while the other "numerical biologist" combines computer science with biology to allow to deal with bioinformatics and big data problems in biology.

Professional competences to be acquired

Biologist:

a) Knowledge:

- He/she has a high level of knowledge about the living systems both at the above and below organism level. Able to apply, organise and develop this knowledge further.

- He/she knows the methods applied in modern field, laboratory and industrial biology.

- He/she knows and is able to apply the terminology and knowledge of the different areas of biology (cell biology, ecology, environmental and nature protection, microbiology, immunology, physiology, animal behaviour, genetics, evolutionary biology, biotechnology, structural biology, syntetic biology, botany and zoology.

- He/she knows the connections between the different biological disciplines and understands the importance of multidisciplinary approaches.

- He/she knows the theoretical and historical aspects of evolution of life on Earth and is able to argue scientifically for this view.

- He/she knows the possibility of applications of modern biological methods, recognises the importance of the development of new methodology and contributes to this development.

- He/she has usable knowledge of natural sciences.

- He/she senses and understands problems of the society which are rooted in biology.

b) Abilities:
- He/she is able to recognise the relationships between different areas of science.

- He/she is able to recognise patterns in social processes related to nature and living organisms.

- He/she is able to carry out scientific research projects and produce (with appropriate supervision) new scientific results.

- He/she is able to use research methods and tools, plan and carry out investigations, interpret and present results of such investigations, learn and develop new methods.

- He/she is able to be a interdisciplinary thinker, build collaborations and coordinate division of labour between members of staff.

- He/she is able to think and act to achieve high level of quality control.

- He/she is able to manage, analyse and interpret scientific data.

- He/she has and develops their skills for precise measurements.

- He/she is able to present and defend his/her views and perform well on job interviews.

- He/she is able to present his/her results and views in biology at a high level both in oral and written form.

- He/she joins the national and international scientific community and is able to communicate his/her results at a high level.

- He/she is able to work in a sustainable way.

c) Attitude:
- He/she aims to know and understand the relations among humans and nature, the structure, function and evolution of humans and other organisms.

- He/she aims to express a responsible point of view about humans and nature, explain their relations for the widest possible audience, and positively influence the public view on biology according to the latest scientific findings.

- He/she sets an example by his/her behaviour concerning environment and nature. He/she acts to push environmental and nature conservation further.

- He/she follows and makes others to follow the ethics of scientific research.

- He/she spread the results of science in an active way even in the media, he/she is able to defend his/her views against pseudoscientific attacks.

- He/she works both in the field and laboratory in a sustainable way and sets examples in this way for others.

- He/she is open to learn new theories and experimental results and is eager to collaborate with others. He/she aims to develop his/her knowledge and set new research directions.

- He/she is committed to do high quality work, to improve his/her own and his/her fellows' knowledge and career.

- He/she is open to develop research consultancy services and spin-offs.

- He/she is open to continuously learn and collaborate with other groups. He/she actively seeks the possibility for personal and professional development and activelyhelps the flow of information.

d) Autonomy and responsibility:

- He/she has the ability to lead small research groups.

- He/she expresses his/her point of view responsibly in professional and non-professional circles about biological research, ethical and bioethical questions.

- He/she puts a great emphasis on work safety under all conditions.

- He/she has the self-determination to organise the work of small groups, and takes responsibility for this.

- He/she knows the legal conditions for safe work. He/she stands on his/her own and his/her fellows interests at different forums and suggests changes to improve work conditions.

- He/she obtains work experience and helps others to work efficiently.

- He/she knowingly builds his/her own career and helps others to do so.

Completion of the MSc Program

The Credit System

Majors in the Hungarian Education System have generally been instituted and ruled by the Act of Parliament under the Higher Education Act. The higher education system meets the qualifications of the Bologna Process that defines the qualifications in terms of learning outcomes: statements of what students know and can do on completing their degrees. In describing the cycles, the framework uses the European Credit Transfer and Accumulation System (ECTS).
ECTS was developed as an instrument of improving academic recognition throughout the European Universities by means of effective and general mechanisms. ECTS serves as a model of academic recognition, as it provides greater transparency of study programs and student achievement. ECTS in no way regulates the content, structure and/or equivalence of study programs.
Regarding each major the Higher Education Act prescribes which professional fields define a certain training program. It contains the proportion of the subject groups: natural sciences, economics and humanities, subject-related subjects and differentiated field-specific subjects.

During the program students have to complete a total amount of 120 credit points. It means approximately 30 credits per semester. The curriculum contains the list of subjects (with credit points) and the recommended order of completing subjects which takes into account the prerequisite(s) of each subject. You can find the recommended list of subjects/semesters in chapter “Model Curriculum of Biology MSc Program”. Students holding BSc degrees in non-biology disciplines may be required to complete additional courses from the Biology BSc curriculum as a condition of their acceptance into and completion of the Biology MSc program.

Starting in 2023, we offer two specializations within the MSc program in Biology. One is a general biology specialization, which includes a broad spectrum of disciplines, the other is called “numerical biology”, which offers specialized courses in the data- and computation-driven fields of bio- and ecoinformatics. Students completing these two specializations will take the same core courses, but develop different expertise facilitated by the specialized modules during their training, and receive a master’s degree in biology with the relevant specialization named. Please refer to the Model Curriculum below for more information on the specific courses within these two specializations.

Model Curriculum of the Biology MSc Program

Knowledge elements, courses and instructors	Semesters				ECTS credit points	evaluation
	1.	2.	3.	4.		
	total contact hours, type of course (l – lecture, s – seminar, p – practice)					
Competences of the core material						
Theoretical foundations module						
1. Biomathematics *Dr. Béla Tóthmérész*	28 s				2	exam, midsemester grade
2. Bioinformatics *Dr. Mátyás Sipiczki*	28 s				2	exam, midsemester grade
3. Biological chemistry *Dr. János Kerékgyártó, László Kalmár*		28 l			2	final exam
4. Cell biology *Dr. Csaba Máthé*			28 l		2	final exam
5. Molecular and synthetic biology *Dr. Ida Miklós*				28 s	2	exam, midsemester grade
6. Genetics *Dr. Hajnalka Csoma*	28 l				2	final exam
Core materials module I („Biology below the level of the organism”)						
1. Physiology, regulatory biology and immunology *Dr. Zoltán Németh, Dr. Ádám Lendvai*			42 l		3	final exam
2. Plant biology *Dr. Csaba Máthé*		42 l			3	final exam
3. Microbiology / Microbial physiology *Dr. Levente Karaffa*				42 l	3	final exam

Core materials module II („Biology at and above the level of the organism”)						
4. Zoology, ethology *Dr. Zoltán Németh*	42 l				3	final exam
5. Evolutionary biology *Dr. Jácint Tökölyi*			42 l		3	final exam
6. Ecology *Dr. Béla Tóthmérész*	42 l				3	final exam
7. Nature conservation and environmental protection *Dr. Béla Tóthmérész, Dr. Péter Török*		42 l			3	final exam
8. Scientific communication *Dr. Török Péter*		42 s			3	exam, midsemester grade
Core materials module III (Project management)						
1. Biometry *Dr. Jácint Tökölyi*		42 p			3	exam, midsemester grade
2. Research planning *Dr. Ádám Lendvai*		28 p			2	exam, midsemester grade
3. Field practical *Dr. Miklós Bán*			42 p		3	exam, midsemester grade
4. Project evaluation and review *Dr. Ádám Lendvai*			28 p		2	exam, midsemester grade
Total credits for core courses	**12**	**16**	**13**	**5**	**46**	
Competences of the general biology specialization						
Genetics						
1. Developmental genetics *Dr. Mátyás Sipiczki*				14 l	1	final exam
2. Gene manipulation and basic genomics *Dr. Zsuzsa Antunovics*		28 s			2	exam, midsemester grade

3. Cell cycle and epigenetics seminar *Dr. Gyula Batta*			28 s		2	exam, midsemester grade
4. Bioregulation and proteomics *Dr. Teréz Barna*	14 l				1	final exam
Plant biology						
1. Plant cell and developmental biology *Dr. Csaba Máthé*		42 l 28 p			3 2	final exam, midsemester grade
2. Plant genetics and biotechnology *Dr. Gyula Surányi,* *Dr. Márta Hamvas,* *Dr. Csaba Máthé,* *Dr. Viktor Oláh*			28 l 28 s		2 2	final exam, midsemester grade
3. Plant molecular taxonomy *Dr. Gábor Sramkó*			28 l 28 p		2 2	final exam, midsemester grade
Ecology						
1. Conservation biology *Dr. Béla Tóthmérész,* *Dr. Péter Török*		14 l 28 s			1 2	final exam, midsemester grade
2. Plant ecology *Dr. Péter Török*		14 l 28 s			1 2	final exam, midsemester grade
3. Animal ecology *Dr. Edina Simon,* *Dr. Roland Horváth*	14 l 28 s				1 2	final exam, midsemester grade
Zoology						
1. Animal populations *Dr. Zoltán Barta*	14 l 14 p				1 1	final exam, midsemester grade
2. Animal behaviour *Dr. Zoltán Németh*		14 l 14 p			1 1	final exam, midsemester grade
3. R programming *Dr. Zoltán Barta, Gergő Oláh*	42 s				3	exam, midsemester grade

4. Conservation genetics *Dr. Nikoletta Nagy*				14 l 28 s	1 2	final exam, midsemester grade
Total credits for specialized courses for general biology	**9**	**15**	**10**	**4**	**38**	
Competences of the numerical biology specialization						
Numerical biology module I						
1. Linux command line *Dr. Miklós Bán*	42 s				4	midsemester grade
2. R programming *Dr. Zoltán Barta, Gergő Oláh*	42 s				3	midsemester grade
3. Python programming *Kornél Ecsedi*		42 s			3	midsemester grade
4. Database management *Dr. Miklós Bán*		42 s			4	midsemester grade
5. Machine learning *Dr. Attila Barta*			28 s		3	midsemester grade
4. Image processing *Dr. Miklós Bán*		14 s			1	midsemester grade
5. Web tools *Dr. Miklós Bán*		14 s			1	midsemester grade
Numerical biology module II						
6. Introduction to bioinformatics *Dr. Nikoletta Nagy*	28 s				3	midsemester grade
1. Genome assembly *Dr. Levente Laczkó*			42 s		4	midsemester grade
2. Genome annotation *Dr. Levente Laczkó*				42 s	4	midsemester grade
3. Transcriptomics *Dr. Nikoletta Nagy*				42 s	4	midsemester grade
6. Geoinformatics *Dr. Miklós Bán* *Dr. Gergely Szabó*				28 s	2	midsemester grade
7. Phylogenomics *Dr. Gábor Sramkó*		28 s			2	midsemester grade

Total credits for specialized courses for numerical biology	**9**	**10**	**6**	**10**	**38**	
Thesis			**210 p / 15 cr**	**210 p / 15 cr**	**30**	practical grade, state exam
Elective courses	in any semester during the graduate program				**6**	
Total credits					**120**	

Work and Fire Safety Course

According to the Rules and Regulations of University of Debrecen a student has to complete the online course for work and fire safety. Registration for the course and completion are necessary for graduation. For MSc students the course is only necessary only if BSc diploma has been awarded outside of the University of Debrecen.
Registration in the Neptun system by the subject: MUNKAVEDELEM
Students have to read an online material until the end to get the signature on Neptun for the completion of the course. The link of the online course is available on webpage of the Faculty.

Physical Education

According to the Rules and Regulations of University of Debrecen a student has to complete Physical Education courses at least in one semester during his/her Master's training. Our University offers a wide range of facilities to complete them.

Pre-degree Certification

A pre-degree certificate is issued by the Faculty after completion of the master's (MSc) program. The pre-degree certificate can be issued if the student has successfully completed the study and exam requirements as set out in the curriculum, the requirements relating to Physical Education – with the exception of preparing thesis – and gained the necessary credit points (120). The pre-degree certificate verifies (without any mention of assessment or grades) that the student has fulfilled all the necessary study and exam requirements defined in the curriculum and the requirements for Physical Education. Students who obtained the pre-degree certificate can submit the thesis and take the final exam.

Thesis

A Thesis is the written communication of the research project the student carries out throughout their studies. By completing this task, the student demonstrates his/her ability, under the guidance of their supervisor, to design, execute, and prepare a report of a research project while using the scientific literature. By submitting and defending a thesis a biologist student certifies that he/she is capable to apply the acquired knowledge in practice and to summarize the completed work and its results in a professional way, to solve the tasks related to his/her topic creatively and to complete an independent professional work.
The requirements of the thesis content, the general aspects of evaluation and the number of credits assigned to the thesis are determined by the requirements of the program. In the Biology MSc Program the total credits assigned to the thesis are 30.

A thesis can be submitted only if it is supported and approved both by the internal supervisor and the external referee. If a thesis is evaluated with a fail mark by the referee and the department the student is not allowed to take the final exam and is expected to prepare a new or modified thesis. The student has to be informed about this decision and the conditions of resubmission.

Final Exam

Students who obtained the pre-degree certificate will finish their studies by taking the final exam of the Biology master program. A final exam is the evaluation of the knowledge and skills acquired during the studies. The candidate has to certify that he/she is able to apply the obtained knowledge in practice. A final exam can be taken in the forthcoming exam period after obtaining the pre-degree certificate. A final exam has to be taken in front of the Committee. If a candidate does not pass his/her final exam until the termination of his/her student status, he/she can take his/her final exam after the termination of the student status on any of the final exam days of the relevant academic year according to existing rules of the state exam.

The Final Exam consists of 3 parts on the basis of its curriculum:

According to the prerequisites of taking a final exam:

- completing all the subjects offered from semester 1 to 4 in the model curriculum, obtaining at least 120 credits according to the curriculum;
- preparing and submitting the thesis (2 semesters, 30 credits).

The final exam (oral exam):

Subjects:

- The core materials of the final exam (T1)
- Materials related to the specialization (T2)
- Grade for the thesis (D1) and grade for the thesis defence (D2)

Calculation of final exam grade (FE) according to this formula:

FE= (T1+T2+ D1+D2)/4

The requirements of the oral part of the final exam, the list of the exam topics with the indication of their literature are announced by the department during the final week of the study period the latest. The oral part of the final exam is evaluated on a five-point scale by the Final Exam Board. The final grade for the exam will be decided on by voting in a closed meeting after the state exam. In case of equal votes, the committee chair will take the decision. Final exam results will be announced by the committee chair.

Retaking a failed Final exam

If any parts of the final exam are evaluated with a fail mark, according to the existing rules of the university, it can be retaken. The next final exam period is the soonest that a new state exam is allowed. If a thesis is evaluated with a solid fail mark by the supervisor and the referee, the graduate is not allowed to take a final exam and a new thesis has to be written. A final exam can be retaken twice on each topic.

Final exam board

Committee chair and members of the committee are selected from the acknowledged internal and external experts of the professional field. The committee consists of – besides the chair – at least two members. The mandate of a Final Examination Board lasts for one year.

Diploma

The diploma is an official document decorated with the coat of arms of Hungary which verifies the successful completion of studies in the Biology Master Program. It contains the following data: name of HEI (higher education institution); institutional identification number; serial number of diploma; name of diploma holder; date and place of his/her birth; level of qualification; training program; specialization; mode of attendance; place, day, month and year issued. Furthermore, it has to contain the rector's (or vice-rector's) original signature and the seal of HEI. The University keeps a record of the diplomas issued.

In Biology Master Program the diploma grade is calculated as the average grade of the results of the followings:

- Weighted average of the overall studies at the program (A)
- Average of grades of the thesis and its defense given by the Final Exam Board (B)
- Average of the grades received at the Final Exam for the two subjects (C)

Diploma grade = (A + B + C)/3

Classification of the award on the bases of the calculated average:

Excellent	4.81 – 5.00
Very good	4.51 – 4.80
Good	3.51 – 4.50
Satisfactory	2.51 – 3.50
Pass	2.00 – 2.50

Course Descriptions of the Biology MSc Program

Title of course: **Biomathematics** **Code**: TTBMG0100_EN	**ECTS Credit points: 2**
Type of teaching, contact hours - lecture: 0 hours/week - practice: 2 hours/week - laboratory: 0 hours/week	
Evaluation: practical grade	
Workload (estimated), divided into contact hours: - lecture: 0 hours - practice: 42 hours - laboratory: 0 hours - home assignment: 28 hours - preparation for the exam: 30 hours Total: 90 hours	
Year, semester: 1st year, 1 st semester	
Its prerequisite(s): **-**	
Further courses built on it: **-**	

Topics of course

A comprehensive introduction to probability, probability distributions, sampling distributions, basic techniques of statistical inference, analysis of variance, linear regression, inference for categorical variables, and nonparametric statistics. This course is designed to teach the students about a variety of mathematical methods which are used in modelling through their application to solving hydrobiological problems. In the practical part of the course students learn the methods of mathematical methods of data processing and planning of experiment.

Literature

Venables, W. N. and Ripley, B. D. 2003: Modern Applied Statistics with S. 4th edition. Springer, New York.

Cox D.R., Donnelly C.A. (2011): Principles of Applied Statistics Cambridge University Press

Wasserman L. (2004): All of Statistics: A Concise Course in Statistical Inference, Springer;

Schedule:

1st week: Practical basic knowledge to the course

2nd week: Techniques and tools of model building in science.

3rd week: Basic usage of the R environment and programming language.

4th week: Basic methods of data management.

5th week: Practical usage of graphical methods in descriptive statistics.

6th week: Basic statistics and statistical distributions of real data

7th week: Exam

8th week: Sampling, design of experiments.

9th week: Analysis of variance (ANOVA) and regression analyses based on R.

10th week: General linear models and generalized linear models in R.

11th week: Models of population dynamics and their implementation in R

12th week: Discrete and continuous models, chaotic dynamics and their programming in R.

13th week: Multispecies communities and diversity. R packages to calculate these methods.

14th week: Exam

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session.

Person responsible for course: Dr. Béla Tóthmérész, professor, DSc

Lecturer: Dr. Béla Tóthmérész, professor, DSc

Title of course: **Bioinformatics** **Code**: TTBMG0105_EN	**ECTS Credit points:** 2

Type of teaching, contact hours
- lecture: -
- seminar: 2 hour/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture:
- seminar: 28 hours
- laboratory: -
- home assignment: -
- preparation for the exam: variable

Total: 28 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Introduction to bioinformatics. The course includes: a general introduction, methods of genome sequencing, genome projects, sequence assemblers, structural and functional annotation of genome sequences, cluster analysis, basic principles of molecular phylogenetics, phenetics and cladistics, distance-based and character-based strategies, UPGMA and WPGMA, neighbor-joining analysis, maximum parsimony analysis, maximum likelyhood analysis and Bayesian methods

Literature

Recommended:
Barnes M.R. and Gray, I.C.: Bioinformatics for Geneticists, Wiley, Chichester, 2013

Schedule:

1st week: Introduction to bioinformatics
2nd week: Methods of genome sequencing and the genome projects
3rd week: Sequence assemblers
4th week: Structural and functional annotation of genome sequences.
5th week: Cluster analysis
6th week: Basic principles of molecular phylogenetics
7th week: Phenetics and cladistics
8th week: Distance-based and character-based strategies
9th week: PGMA methods: UPGMA and WPGMA
10th week: Neighbor-joining analysis
11th week: Maximum parsimony analysis
12th week: Maximum likelyhood analysis
13th week: Bayesion methods

14th week: End-of-semester consultation
Requirements: Attendance at lectures is recommended, but not compulsory. Attendance at seminars is compulsory. During the semester, there are two tests: in the 6th week and in the 10th week. Students have to sit for the tests but the results of the tests are not taken into consideration at the end-of-semester examination. Semester ends with examination and signature. Examination (lectures): The end-of-semester examination is based on the lectures, no additional reading is required. The students answer questions is the standard assay form. No time limit is set for writing the answers. Each answer is evaluated individually using the standard five-grade system. The final examination grade is the average of the individual grades. If necessary, students can also be examined orally. Signature (seminar): Signature is given for the attendance at seminars. More than three absences are not permitted.
Person responsible for course: Dr. Mátyás Sipiczki DSc, professor emeritus
Lecturer: Dr. Mátyás Sipiczki DSc, professor emeritus

Title of course: **Biological chemistry** **Code**: TTBME0115_EN	**ECTS Credit points:** 2

Type of teaching, contact hours
- lecture: 2 hours/week
- seminar: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: 28 hours
- preparation for the exam: 40 hours

Total: 96 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s):-

Further courses built on it:-

Topics of course

The aim of the course is to give students a basic knowledge of bio-organic chemistry. Molecular design of life: properties and biological functions of amino acids, peptides, proteins, carbohydrates, nucleic acids, lipids. Biological membranes.

Literature

Compulsory:
- P. Gergely, Organic and bioorganic chemistry for medical students, University of Debrecen, 2004.

Recommended:
- A. L. Ternay, Jr. Contemporary Organic Chemistry, W. B. Saunders Co., 1979.
- Lubert Stryer, Biochemistry, W. H. Freeman and Company, New York, 2002, ISBN 1-7167-4684-0.

Schedule:

1st week: Introduction to biological chemistry. Molecular design of life. Macromolecules of living organisms.

2nd week: Amino acids. Genetically coded and rare amino acids. Characteristics of the amino and carboxyl groups.

3rd week: Peptides and proteins. Primary, secondary, tertiary, quaternary structures. Levels of structure in protein architechture. Biological functions of proteins.

4th week: Determination of peptide and protein structures. Electrophoreses, ultracentrifugation, chromatography. Edman degradation.

5th week: Purification and analysis of proteins. Gel electrophoreses, gel-filtration chromatography, dialysis. Determination of molecular weights of proteins.

6th week: Synthesis of peptides. The Merrifield solid-phase peptide synthesis. Protecting groups.

7th week: The mid-term test.

8th week: Carbohydrates. Characteristics of the oxo-compounds and alcohols. Biological roles of carbohydrates. Monosaccharides, aldoses, ketoses, pentoses, hexoses. Stereochemistry of carbohydrates. Ring structure of monosaccharides. Conformation of pyranose and furanose rings.

9th week: Oligosaccharides, polysaccharides. Glycoconjugates. Structure of glycolipids and glycoproteins occurring in cell membranes. Cell surface glycans mediate uncountable biological events such as viral and bacterial infection, tumorigenesis, immune response and receptor-mediated signaling processes.

10th week: Chemical reactions of carbohydrates. Preparation of esters, ethers, acetals, oxidation, reduction. Protecting groups in carbohydrate chemistry. Synthesis of glycosides and oligosaccharides.

11th week: Lipids. Classification of lipids. Saponifiable and non-saponifiable lipids. Membrane lipids: phospholipids, glycolipids, cholesterol. Biological membranes.

12th week: Nucleic acides. The structure of DNA and RNA. The Watson-Crick DNA double helix. Circular and supercoiled DNA.The biological role of RNA.

13th week: Other, biologically important organic compounds.

14th week: The end-term tests.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week. Students have to sit for the tests

- for a grade

The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

the average grade of the two designing tasks
the result of the examination
The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade: it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

Person responsible for course: Dr. János Kerékgyártó, senior research fellow, CSc, PhD
Lecturer: Dr. János Kerékgyártó, senior research fellow, CSc, PhD

Title of course: **Cell biology** **Code**: TTBME0120_EN	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: -
- laboratory: -

Evaluation: examination

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 40 hours

Total: 68 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s): Cell Biology (BSc level)

Further courses built on it: -

Topics of course

The cell as the basic unit for the structure and functioning of living organisms, is highly complex and dynamic. The principal aim of this course is to show the mechanisms of those complex interactions that characterize pro- and eukaryotic cells (focusing on eukaryotes) that will result in functioning of the cell as a whole.

Literature

Compulsory:

- Alberts, B. et al. (Eds.) (2008, 2010, 2013): Molecular biology of the cell/Essential Cell Biology. Garland Science/ Taylor and Francis Group

Recommended:

- Buchanan BB, Gruissem W, Jones RL, eds. (2000, 2015) Biochemistry and Molecular Biology of Plants. Blackwell-ASPB Books.

Schedule:

1st week: General informations. Introduction into the main topics of cell biology that will be discussed during the semester.

2nd week: A survey of the topics discussed on the Cell Biology/ BSc course: the prokaryotic and eukaryotic/ fungal, plant, animal-human cell. Discussion of the topics presented at the lecture.

3rd week: Dynamics of subcellular structures, the role of cytoskeleton and endomembranes in intracellular movement. Discussion of the topics presented at the lecture. Modern techniques related to the study of intracellular dynamics.

4th week: Gene expression in the context of cell functioning, the coordinated functioning of nuclear and extranuclear genomes. Discussion of the topics presented at the lecture. Modern techniques related to the study of gene regulation.

5th week: Post-translational modifications of proteins: phosphorylation/dephosphorylation, ADP-ribosylation, ubiquitination etc. Their role in the regulation of subcellular events. Discussion of the topics presented at the lecture. Modern techniques related to the study of post-translational modifications.

6th week: Types of signal transduction and their pathways. Signal transduction cascades. Their role in the functioning of cell as a whole. Discussion of the topics presented at the lecture. Modern techniques related to the study of signal transduction.

7th week: Typical examples of hormone or growth regulator mediated signal transduction pathways. Discussion of the topics presented at the lecture. Modern techniques related to the study of signal transduction.

8th *week:* The cytoskeleton as the driving force of cellular dynamics. Microtubules, microfilaments and intermediate filaments. Discussion of the topics presented at the lecture. Modern techniques related to the study of cytoskeleton.

9th week: Dynamics of biological membranes. Current models of membrane structure and dynamics. Discussion of the topics presented at the lecture. Modern techniques related to the study of biological membranes.

10th week: The endomembrane system of eukaryotic cells. Interaction between membrane compartments and their dynamics. Discussion of the topics presented at the lecture. Modern techniques related to the study of endomembranes.

11th week: The extracellular matrix of eukaryotic cells. The glycocalyx, the fungal and plant cell wall, their structure and functions. Discussion of the topics presented at the lecture. Modern techniques related to the study of extracellular matrix.

12th week: Discussion of cell cycle regulation issues learned during the BSc courses. Molecular mechanisms of the regulation of mitosis and meiosis. Deregulation of mitosis, tumorigenesis. Discussion of the topics presented at the lecture. Modern techniques related to the study of the regulation of cell division.

13th week: Programmed cell death and apoptosis: the concept, pathways, their role in the development of multicellular organisms. Discussion of the topics presented at the lecture. Modern techniques related to the study of PCD.

14th week: Consultation: a survey of the topics discussed during the semester.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

- for a grade

The course ends in an **examination** in case of the lecture.

The minimum requirement for both the examination and laboratory grade is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the

EDUCATION AND EXAMINATION RULES AND REGULATIONS. *-an offered grade:* it may be offered for students if the average grade of the designing tasks is at least satisfactory (3)
Person responsible for course: Dr. Csaba Máthé, associate professor, PhD
Lecturer: Dr. Csaba Máthé, associate professor, PhD

Title of course: **Molecular and synthetic biology** **Code**: TTBMG0125_EN	**ECTS Credit points:** 2

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 24 hours
- preparation for the exam: 24 hours

Total: 76 hours

Year, semester: 2nd year, 2nd semester

Its prerequisite(s): TTBG0105-EN

Further courses built on it: -

Topics of course

In the first part, we review the molecular methods used in the thesis of the students, we discuss them in detail, try to find the possible problems and their solutions. We review molecular identification of the species, mitochondrial DNA, barcoding and its application. The second part focuses on systems biology, metabolic networks, approaches and tools directly utilized in synthetic biology, synthetic genomes and gene editing. Virtual experiment design.

Literature

Recommended:

RJ Reece: Analysis of Genes and Genomes , Wiley and Sons LtdISBN:0-470-84379-9

Schedule:

1st week: Review of basic molecular methods.

2nd week: Presentation. Discussion of the molecular method used, possible problems and their solutions.

3rd week: Presentation. Discussion of the molecular method used, possible problems and their solutions.

4th week: Presentation. Discussion of the molecular method used, possible problems and their solutions.

5th week: Presentation. Discussion of the molecular method used, possible problems and their solutions.

6th week: Presentation. Discussion of the molecular method used, possible problems and their solutions.

7th week: Presentation. Discussion of the molecular method used, possible problems and their solutions.

8th week: Genome, genome projects, genes, mitochondrial DNA. Finding genes in the databases.

9th week: Molecular identification of species, barcoding. Designing the experiment, required tools and methods, analysis of the results.

10th week: Synthetic biology, synthetic genomes, construction of *Mycoplasma mycoides* minimal genome.
11th week: Metabolic networks and gene editing.

12th week: Virtual lab.

13th week: Consultation.

14th week: Essay writing.

Requirements:

Participation at practice classes is compulsory. A student must attend the practice classes and may not miss more than three times during the semester.

Students have to submit a presentation.

- *for a grade*
The course ends in an **examination**.

The minimum requirement is 50%.

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Ida Miklós, associate professor, PhD

Lecturer: Dr. Ida Miklós associate professor, PhD

Title of course: **Genetics** **Code**: TTBME0130_EN	**ECTS Credit points:** 2

Type of teaching, contact hours
- lecture: 2 hours/week
- practice:-
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: variable

Total: 28 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it:-

Topics of course

The aim of the course is to introduce special genetic topics not discussed in the basic genetics course.

Molecular mechanism of genetic recombination: detection of crossing over, gene conversion and postmeiotic segregation. Molecular models of genetic recombination. Mobile genetic elements: insertion sequences, transposons, inversion elements, retro sequences. The mechanisms of conservative, replicative and retro-transposition. Genetic transformation. Generalized transduction. Specialized transduction. Bacterial conjugation. R-factors and other plasmids. Extracromosomal inheritance: the construction of chondriome and plastome, mitochondrial inheritance.

Literature

Compulsory:

-

Recommended:

-

Schedule:

1st week

Description the course themes and requirements.

Review of the processes of mitosis and meiosis.

2nd week

Molecular mechanism of genetic recombination I: detection of crossing over, gene conversion and postmeiotic segregation.

3rd week

Molecular mechanism of genetic recombination II: molecular models.

4th week

Mobilis genetic elements I: insertion sequences, transposons.

5th week

Mobilis genetic elements II: retro sequences, retro elements, retrons, retroposones, retroviruses, pararoviruses.

6th week

Mobilis genetic elements III: the mechanisms of conservative, replicative and retro-transposition.

7th week

Genetic transformation.

8th week

Transduction in bacteria: generalized transduction.

9th week

Transduction in bacteria: specialized transduction.

10th week

Conjugation in bacteria. R-factors and other plasmids.

11th week

Extrachromosomal inheritance I: the structure of chondriome and inheritance associated with mitochondria.

12th week

Extrachromosomal inheritance II: pollensterility and phylogenetic aspects.

13th week

Extrachromosomal inheritance III: the plastome and eukaryotic plasmids.

14th week

Consultation.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

- for a grade

The course ends in an **examination**.

The minimum requirement for the examination respectively is 60%.

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade: -

Person responsible for course: Dr. Csoma Hajnalka assistant professor, PhD

Lecturer: Dr. Csoma Hajnalka assistant professor, PhD

Title of course: **Physiology, Regulatory Biology and Immunology** **Code**: TTBME0200_EN	**ECTS Credit points:** 3

Type of teaching, contact hours
- lecture: 3 hours/week
- practice: 0 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 42 hours
- practice: 0 hours
- laboratory: -
- home assignment: 20 hours
- preparation for the exam: 20 hours

Total: 82 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s):

Further courses built on it: -

Topics of course

The objective of the course is to equip students with a strong foundation of fundamental physiological regulatory processes, which will enable them to acquire more specialized knowledge later in their career. Students will review homeostatic regulatory processes, organismal response to immune challenge and environmental stress, while a strong emphasis will be placed on methodological and technical details throughout the course.

Topics: introduction to physiological principles. Chemistry, biochemistry, and cell physiology. Hormones and cell signalling. Homeostasis. Maintaining the balance of heat, water, nutrients and energy. Principle and limitations of economic design. Whole body integration of regulatory systems. Regulation of self-maintenance and reproduction. The immune system. Innate and acquired immunity. Immunisation and its use in public health and assay development.

Literature

Compulsory:

1. Course material

Recommended:

- Moyes, C.D., Schulte, P.M.: Principles of animal physiology, Pearson (3rd edition, 2015)

Schedule:

1st week: Introduction to physiological principles. Physiological evolution of animals

2nd week: Chemistry, biochemistry, and cell physiology

3rd week: Cell signaling and endocrine regulation

4th week: Neuron structure and function

5th week: Cellular movement and muscles

6th week: Sensory systems

7th week: Functional organization of nervous systems

8th week: Circulatory systems

9th week: Immune systems. Immunisation and its use in public health and assay development.

10th week: Respiratory systems

11th week: Locomotion

12th week: Ion and water balance. digestion and energy metabolism

13th week: Thermal physiology

14th week: Reproductive physiology

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class.

During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests

- for a grade

The course ends in an **examination**. Based on the average of the grades of home assignments and the examination, the exam grade is calculated as an average of them:

- the average grade of home assignments
- the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade: -

Person responsible for course: Dr. Adam Z Lendvai, associate professor, PhD
Lecturer: Dr. Adam Z Lendvai, associate professor, PhD Dr. Zoltan Nemeth, assistant professor, PhD

Title of course: **Plant biology** **Code**: TTBME0205_EN	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: -
- laboratory: -

Evaluation: examination

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: 40 hours

Total: 68 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The dynamic plant cell. Regulation of plant cell cycle. Structure and functioning of the plant genome. Molecular regulation of photosynthesis. Light regulated gene expression. Hormonal and genetic regulation of plant development: embryogenesis, root, shoot and flower. Stress reactions and programmed cell death in plants. Secondary metabolism.

Literature

Compulsory:
- Jones R, Ougham H, Thomas H, Waaland S, eds. (2013) The molecular life of plants. Wiley-Blackwell

Recommended:
- Buchanan BB, Gruissem W, Jones RL, eds. (2000, 2015) Biochemistry and Molecular Biology of Plants. Blackwell-ASPB Books.
- Fosket DE, Morejohn, LC (1992) Structural and functional organization of tubulin. Annu. Rev. Plant Physiol. Plant Mol. Biol. 43: 201-240.
- Greenberg JT (1997) Programmed cell death in plant-pathogen interactions. Annu. Rev. Plant Physiol Plant Mol. Biol. 48: 525-545.
- Kuriyama H, Fukuda H (2002) Developmental programmed cell death in plants. Curr. Op. Plant Biol. 5: 568-573.

Schedule:

1st week: General informations. Introduction into the main topics of plant molecular biology.

2nd week: The dynamic plant cell. The coordination between ER and microtubules for the concerted functioning of plant cell. Dynamics of organelles, with special emphasis on vacuoles. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell dynamics.

3rd week: Organization of nuclear and organellar genome, particularities of transcription and translation in plants. Special plant proteins. Biotechnological aspects. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant molecular genetics.

4th week: Gene regulation in plants, with special emphasis on light-regulated expression. Post-transcriptional and post-translational regulation in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant gene regulation as well as post-transcriptional and post-translational regulations.

5th week: Particularities of the organization of plant cytoskeleton. Cell cycle regulation in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cytoskeleton and cell cycle regulation.

6th week: Photoreceptors: phytochromes, blue and UV receptors. Signal transduction events in photomorphogenesis. Regulation of gene expression by phytochromes. Chronobiology in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of photomorphogenesis.

7th week: Electron transport proteins in photosynthesis. Short characterization of the Calvin cycle. Molecular/ gene regulation of C- and N metabolism in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of C- and N metabolism in plants.

8th week: Signal transduction events mediated by plant growth regulators, with special emphasis on auxins. Functions of PIN proteins (auxin efflux carriers). Discussion of the topics presented at the lecture. Modern techniques related to the study of plant hormone mediated signal transduction and auxin transport.

9th week: Molecular mechanisms of embryo and root development, the role of plant growth regulators. Discussion of the topics presented at the lecture. Modern techniques related to the study of embryo and root development.

10th week: Molecular mechanisms of shoot and flower development, the role of plant growth regulators. Flower identity genes: the role of MADS box (homeotic) genes, analogies with homeobox genes-regulated developmental processes in animals. Discussion of the topics presented at the lecture. Modern techniques related to the study of shoot and flower development.

11th week: Plant responses to abiotic and biotic stresses. The formation of reactive oxygen species. Antioxidant systems and metabolites in plants. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant stress responses.

12th week: Molecular mechanisms of senescence and plant cell death in plants. Plant-pathogen interactions, the hypersensitive response. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell death. Students present selected topics of this subject on the basis of scientific papers.

13th week: Secondary metabolism in plants, their synthesis. Terpenoids, alkaloids, phenoloids, polyketides. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant secondary metabolism.

14th week: Functions, effects of special plant metabolites. Allelopathy. Discussion of the topics presented at the lecture. Modern techniques related to the study of plant special metabolites.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

- for a grade

The course ends in an **examination** in case of the lecture.

The minimum requirement for both the examination and laboratory grade is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade:
it may be offered for students if the average grade of the designing tasks is at least satisfactory (3)

Person responsible for course: Dr. Csaba Máthé, associate professor, PhD

Lecturers: Dr. Csaba Máthé, associate professor, PhD
Dr. Ilona Mészáros, associate professor, PhD
Dr. Márta M-Hamvas, associate professor, PhD
Dr. Gyula Surányi, senior lecturer, C.Sc.
Prof. Gábor Vasas, PhD, DSc

Title of course: Microbiology/Microbial physiology **Code**: TTBME0210_EN	**ECTS Credit points:** 3
Type of teaching, contact hours - lecture: 3 hours/week - practice: - - laboratory: -	
Evaluation: exam (written)	
Workload (estimated), divided into contact hours: - lecture: 42 hours - practice: - - laboratory: - - home assignment: 40 hours - preparation for the exam: 40 hours Total: 122 hours	
Year, semester: 2nd year, 2nd semester	
Its prerequisite(s): -	
Further courses built on it: -	
Topics of course	
The aim of this course is two-fold: first, it is to obtain a general understanding of the microorganisms (bacteria, fungi, yeasts, viruses), that includes their classification, metabolism, the way they interact with their environment and other living organisms such as plants, animals and humans. We will characterize the cellular biology of the microorganisms (cell wall, cell membrane, intracellular structures), and analyse their functions. Energy metabolism and reproduction will be discussed. Secondly, the course also deals with the applied aspects of microbiology including industrial fermentations (biogas, ethanol, hydrogen formation), environmental applications (bioremediation, biodegradation), agricultural as well as food technologies (preservation, food and feed production).	
Literature	
Compulsory: Dawes IW, Sutherland IW: Microbial physiology. Blackwell Publishing, New York, U.S.A. *Recommended:* PM Rhodes, PF Stanbury: Applied Microbial Physiology – A Practical Approach. Oxford University Press, Oxford, UK	
Schedule: *1st week: Principles of Microbiology* Introduction – microorganisms and microbiology. A brief journey to the microbial world. Chemistry of cellular components. Cell structure and function in *Bacteria* and *Archaea*. Nutrition and culture of microorganisms. Microbial growth. *2nd Week: Microbial metabolism I.* Microbial biochemistry. Carbon catabolism and anabolism. Regulation of carbon metabolism. Carbohydrates and lipids. Carbon source vs. energy source. *3rd Week: Microbial metabolism II.* Microbial genetics. Structure and composition of DNA and RNA. *4th Week: Microbial metabolism III.* Amino acid biosynthesis and its regulation. Nucleic acid metabolism.	

5th Week: Microbial metabolism IV.

Sexual and asexual processes. Parasexual cycle. Regulation of Gene Expression. Protein synthesis and degradation.

6th Week: Molecular Biology of Microorganisms

Essentials of Molecular Biology. Archaeal and Eukaryotic Molecular Biology. Overview of Viruses and Virology. Principles of Bacterial Genetics. Genetic Engineering. Microbial Genomics.

7th Week: Industrial microbiology: Upstream processing

Bioreactor instrumentation and control. Sensors. Control systems – manual and automatic control. On-line analysis. Sterilization. Cell morphology. Inoculum preparation. Batch, fed-batch and continuous fermentation systems.

8th Week: Industrial microbiology: Downstream processing

Recovery and purification. Filtration, centrifugation, cell disruption, liquid-liquid extraction, solvent recovery, chromatography, crystallization, whole-broth processing. Fermentation analytics. Physical, chemical and biological (aerobic and anaerobic) treatment of the effluent. Fermentation economics.

9th Week: Microbial enzymes

Bioprocesses engineering of enzymes. Enzyme isolation. Classification of enzymes of industrial importance. Enzyme kinetics. Enzyme reactions in homogenous and heterogenous phase. Bioconversions. Enzyme immobilization.

10th Week: Microbial bulk products

Biomass production (SCP). Amino acid processes. Organic acid processes. Vitamin C and vitamin B_{12} production. Biofuels – general outlook, classification, economic importance. Antibiotics – history, biosynthesis, biotechnology, application.

11th Week: Microbial Diversity

Microbial Evolution and Systematics. Bacteria: The Proteobacteria. Bacteria: Gram-Positive and Other Bacteria. Archaea. Eukaryotic Cell Biology and Eukaryotic Microorganisms. Viral Diversity.

12th Week: Metabolic Diversity and Microbial Ecology

Metabolic Diversity: Photography, Autotrophy, Chemolithotrophy, and Nitrogen Fixation. Metabolic Diversity: Catabolism of Organic Compounds. Methods in Microbial Ecology. Microbial Ecosystems. Nutrient Cycles, Bioremediation, and Symbioses.

13th Week: Important microorganisms in agriculture and industry

Brevibacterium sps., Lactobacillus, Lactococcus,Streptococcus, Tetragenococcus, Carnobacterium, Weisella, Azotobacter chroococcum, Streptomyces sps., Botrytis cinerea, Plasmopara viticola, Uncinula necator.

14th Week: Important microorganisms in agriculture and industry

Penicillium sps, Aspergillus sps, Trichoderma sps., Rhizopus sps., Saccharomyces sps, Zymomonas sps, Corynebacterium glutamicum,

Requirements:

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for the tests.

- for a grade
The course ends in an **examination**. Based on the average of the grades of the designing tasks and the examination, the exam grade is calculated as an average of them:

- the average grade of the two designing tasks
- the result of the examination

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade:
it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

Person responsible for course: Dr. Levente Karaffa, associate professor, PhD, DSc.

Lecturer: Dr. Levente Karaffa, associate professor, PhD, DSc.

Title of course: **Zoology, ethology** **Code**: TTBME0215_EN	**ECTS Credit points:** 3

Type of teaching, contact hours
- lecture: 3 hours/week
- practice: 0 hours/week
- laboratory: 0 hours/week

Evaluation: exam grade

Workload (estimated), divided into contact hours:
- lecture: 56 hours
- practice: 0 hours
- laboratory: 0 hours
- home assignment: 30 hours
- preparation for the presentation: 30 hours

Total: 116 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it:-

Topics of course

The objective of the course is twofold, first to enable students to integrate previously acquired knowledge from the fields of zoology, animal behaviour, evolution and ecology, second, to use that knowledge to critically evaluate the latest studies of organismal response to urbanization and human induced rapid environmental change. The students will primarily learn about novel adaptations (behavioural, physiological, and morphological), which have recently appeared in response to colonization of built, urban environments in diverse taxonomic groups of animals. More than half of the global human population now resides in cities, therefore it is important that students become familiar with the effects of rapidly expanding urban environments on native organisms.

Literature

- Diego Gil and Henrik Brumm (eds.): Avian Urban Ecology: Behavioral and Physiological Adaptations. (Oxford University Press, 2014)
- Ulrika Candolin and Bob B. M. Wong (eds.) Behavioral Responses to a Changing World: Mechanisms and Consequences (Oxford University Press, 2012)

Schedule:

1st week: Introduction: Cities as evolutionarily novel environments. Urban ecosystems.

2nd week: Behavioural and ecological predictors of the propensity to colonize urban environments.

3rd week: Urban heat islands. Effects of light pollution.

4th week: Cities as never depleting food sources.

5th week: Urban phenology: timing of reproduction in cities.

6th week: Communication in urban noise.

7th week: Urban predators.

8th week: Cities as sources of novel parasites and pathogens.

9th week: Effects of toxins and heavy metal pollution in urban areas.

10th week: Roles of phenotypic plasticity and genetic adaptation in urbanization.

11th week: Speciation in urban areas.

12th week: Invasive species in urban areas.

13th week: Research methods of adaptations to urban environments.

14th week: Student presentations.

Requirements:

Participation at the classes is compulsory. A student may not miss more than three lectures during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

Students will be evaluated based on two deliverables: (1) a brief, 15 min oral presentation given on the last class (14th week) on the topic of an adaptation to the urban environment, (2) a mini-review type paper submitted on the topic of the oral presentation.

The minimum requirement for both the presentation and the paper is 60%. The final grade will be composed (averaged) from the grades given to the presentation and the paper. Grades are given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Zoltán Németh, PhD, assistant professor

Lecturer: Dr. Zoltán Németh, PhD, assistant professor

Title of course: **Evolutionary Biology** **Code**: TTBME0220_EN	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 3 hours/week
- practice: 0 hours/week
- laboratory: 0 hours/week

Evaluation: written exam

Workload (estimated), divided into contact hours:
- lecture: 42 hours
- practice: 0 hours
- laboratory: 0 hours
- home assignment: 0 hours
- preparation for the exam: 40 hours

Total: 82 hours

Year, semester: 1st year, 3rd semester

Its prerequisite(s):

Further courses built on it:

Topics of course

The Modern Synthesis of evolutionary biology. Evolution basics. Levels of selection. Evolution of individuality. Evolutionary conflicts. Genome evolution. Evolution of genetic regulatory systems. Evolution of development. Phenotypic plasticity and evolution of reaction norms. Epigenetics and evolution. Evolution of sex. Phylogenetics. Evolution of biodiversity. Darwinian medicine: evolution of pathogens, antimicrobial resistance, cancer.

Literature

Futuyma, D. J. & Kirkpatrick, M. (2017). Evolution 4th Ed. Sinauer

Maynard Smith, J & Szathmáry, E. (1995). The major transitions in evolution. Oxford University Press.

Buss, L. W. (1988). The evolution of individuality. Princeton University Press.

West-Eberhard, M. J. (2003). Developmental plasticity and evolution. Oxford University Press

Ewald, P. W. (1994) Evolution of infectious disease. Oxford University Press

Burt, A. & Trivers, R (2008). Genes in conflict. Harvard University Press

Schedule:

1st week: The Modern Synthesis of evolutionary biology.

2nd week: Evolution basics.

3rd week: Levels of selection.

4th week: Evolution of individuality.

5th week: Evolutionary conflicts.

6th week: Genome evolution.

7th week: Evolution of genetic regulatory systems.

8th week: Evolution of development.

9th week: Phenotypic plasticity and evolution of reaction norms.

10th week: Epigenetics and evolution.

11th week: Evolution of sex.

12th week: Phylogenetics.

13th week: Evolution of biodiversity.

14th week: Darwinian medicine: evolution of pathogens, antimicrobial resistance, cancer.

Requirements:
Participation at the classes is not compulsory.

The minimum requirement for the exam 60%. Grades are given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Jácint Tökölyi, assistant professor, PhD

Lecturer: Dr. Jácint Tökölyi, assistant professor, PhD

Title of course: **Ecology** **Code**: TTBME0225_EN	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 3 hours/week
- practice: 0 hours/week
- laboratory: 0 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 42 hours
- practice: 0 hours
- laboratory: 0 hours
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 122 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The aim of the course to introduce the basic ecological processes and their effect on the environment and nature. Besides providing the state-of-art theoretical background, case studies will also be provided to each topic in order to reveal practical aspects. The course provide knowledge on the aspects of vegetation succession; global and local effects of land use changes, habitat loss and fragmentation; ecological processes in urban habitats; ecosystem services and estimation of the ecological footprint; application of remotely sensed data in environmental and conservational projects.

Literature

Pásztor L., Botta-Dukát Z., Magyar G., Czárán T., Meszéna G. (2016) Theory-Based Ecology A Darwinian approach. Oxford University Press, pp. 301. ISBN: 978-01-995-7785-9

Whittaker, R.J., Fernández-Palacios, J.M. 2007: Island Biogeography Ecology, evolution, and conservation. Oxford Univ. Press, USA ISBN 978-01-985-6612-0

Schedule:

1st week: Introduction to the course

2nd week: Role of small habitat islands in human transformed landscapes – nature conservation, cultural and ecosystem services

3rd week: Island biogeography

4th week: Ecological impacts of invasive plant and animal species in a changing world

5th week: Application of remote sensing in ecology

6th week: Ecosystem services and ecological footprint

7th week: Mid-term test

8th week: Ecological succession

9th week: Conservation and management of grassland ecosystems

10th week: Urbanisation, urban ecology

11th week: Role of ecosystem engineering species in natural habitats

12th week: Sustainable land use

13th week: Ecology and agriculture

14th week: End-term test

Requirements:

- for a signature

Participation at classes is compulsory. A student must attend the classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. In case of more than three absences, a medical certificate needs to be presented.

-an offered grade:

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week. The offered grade is the average of them.

The minimum requirement for the tests (and also for the examination) is 60%. The grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

- for a grade

The course ends in a written exam. For the grades please refer the table above.

Person responsible for course: Prof. Dr. Béla Tóthmérész, professor, DSc

Lecturer: Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török, professor, DSc,

Title of course: **Nature conservation and environmental protection** **Code**: TTBME0230_EN	**ECTS Credit points:** 3

Type of teaching, contact hours
- lecture: 3 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 42 hours
- practice: -
- laboratory: -
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 122 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Presenting environmental knowledge based on ecological background. Reviewing the actual problems, tasks and challenges in environmental protection. To understand the main questions of the environmental protection and relationship between the environmental protection and the human culture. Introducing nature conservation using ecological knowledge. This course establishes the basis needed for the involvement in the nature conservation.

Literature

Compulsory:

1. Fiedler, P.L. (ed.) 2013: Conservation Biology: The Theory and Practice of Nature Conservation Preservation and Management. Springer
2. Newman, E. I. 2008: Applied Ecology and Environmental Management. Blackwell Science Ltd., Oxford.
3. Gafta, D., Akeroyd, J. R. (eds.) 2006: Nature Conservation: Concepts and Practice. Springer

Recommended:

-

Schedule:

1st week: Introduction to the course.

2nd week: Nature, nature conservation. History of the nature conservation.

3rd week: Biodiversity. Spatial and temporal pattern of the biodiversity.

4th week: Population dynamics. Factors affecting the survival of populations. Conservation of populations.

5th week: Species-level conservation. Rarity and frequency. Ex-situ and in-situ conservation.

6th week: Community-level conservation. Keystone species, functional species groups. Community dynamics and stability. Disturbances, invasion.

7th week: Mid-term test.

8th week: Environment and environmental elements. Inter-, multi- and transdisciplanirity in environmental science. Environmental problems and activities.

9th week: Atmosphere and its components. Air pollution. Air-related local and global environmental problems.

10th week: Water as environmental element. Water quality. Water pollution. Water-related local and global environmental problems.

11th week: Sewage treatment. Physical, chemical, and biological processes. Sewage sludge treatment.

12th week: Waste management. Waste-related local and global environmental problems.

13th week: Environmental noise, noise pollution. Noise control, noise mitigation.

14th week: End-term test

Requirements:

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week. Students have to sit for the tests

- *for a grade*

The course ends in an **examination**.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)

90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade:
it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

Person responsible for course: Prof. Dr. Béla Tóthmérész, professor, DSc

Lecturer: Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török, professor, DSc,

Title of course: **Scientific communication and proposal writing** **Code**: TTBMG0235_EN	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 4 hours/week
- laboratory: 0 hours/week

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 56 hours
- laboratory: 0 hours
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 136 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The course aims at to provide essential information in scientific communication and helps the students to develop their own research profile by supporting their skills in scientific writing and communication. The course introduces the essential indicators of scientific performance (impact factor, citation metrics, journal ranking) and provide guidelines for journal selection for their results in biological sciences. The students will be provided with the necessary tools of scientific writing, scientific presentations (scientific poster and oral presentation), paper writing and basic tools in proposal and grant writing.

Literature

- David H. Foster (2017): A concise guide to communication in science and engineering. Oxford University Press, Oxford.
- Ken Peach (2017): Managing Science – Developing your Research Leadership and Management Skills. Oxford University Press, Oxford.
- Heard S.B. (2016): The Scientist's Guide to Writing: How to Write More Easily and Effectively throughout Your Scientific Career. Princeton University Press, Princeton.

Schedule:

1st week: Essentials of scientific policy and communication

2nd week: Brief introduction to measuring science and scientometrics

3rd week: Formal and informal scientific communication

4th week: Scientific conference proceedings and poster presentations

5th week: Type of scientific papers, books and book chapters

6th week: Essentials of paper writing I

7th week: Essentials of paper writing II

8th week: Essentials of paper writing III

9th week: Manuscript submission and review

10th week: Editorial work and manuscript reviews

11th week: Management of the own scientific profile

12th week: Scientific group management and proposal writing I

13th week: Scientific group management and proposal writing II

14th week: End-term test

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

Person responsible for course: Dr. Péter Török, associate professor, PhD, habil, D.Sc.

Lecturer: Dr. Péter Török, associate professor, PhD, habil, D.Sc.

Title of course: **Developmental genetics** **Code**: TTBME1000_EN	**ECTS Credit points:** 1

Type of teaching, contact hours
- lecture: 1 hour/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: -
- laboratory: -
- home assignment: -
- preparation for the exam: variable

Total: 14 hours

Year, semester: 2nd year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Introduction to developmental genetics. The course includes: a general introduction, the description of the major model organisms, the genetic factors determining polarity and positional information, segmentation, organogenesis, evolutionary disorders and the genetic determination of immunoglobulins.

Literature

Recommended:
Gilbert, S.F.: Developmental Biology. 11th Edition. Sinauer Associates Inc, Suderland, USA, 2016

Schedule:

1st week: Introduction to developmental biology and developmental genetics

2nd week: Basic principles

3rd week: Cenorhanditis elegans as model organism

4th week: Genetic determination and regulation of development in *Cenorhabditis elegans*

5th week: Description and characterisation of *Drosophila melanogaster* as a model organism

6th week: Establishing positional information in *Drosophila* as the starting process of development

7th week: Anterior-posterior subdivision of the *Drosophila* embryo

8th week: Establishing segmentation in the *Drosophila* embryo

9th week: Establishing segment identity in the *Drosophila* embryo

10th week: Organogenesis in *Drosophila* *11th week:* Disorders of evolutionally conserved genes in human *12th week:* Early development in mammals and stem cells *13th week:* Genetics of immunoglobulins *14th week:* End-of-semester consultation
Requirements: Attendance at lectures is recommended, but not compulsory. During the semester there are two tests: in the 6th week and in the 10th week. Students have to sit for the tests but the results of the tests are not taken into consideration at the end-of-semester examination. The end-of-semester examination is based on the lectures, no additional reading is required. The students answer questions is the standard assay form. No time limit is set for writing the answers. Each answer is evaluated individually using the standard five-grade system, and the final examination grade is the average of the individual grades. If necessary, students can also be examined orally.
Person responsible for course: Prof. Dr. Mátyás Sipiczki DSc, professor emeritus
Lecturer: Prof. Dr. Mátyás Sipiczki DSc, professor emeritus

Title of course: **Gene manipulation and Genomics** **Code**: TTBME1010_EN	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 2 hours/week
- laboratory: 0 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: hours
- practice: 28 hours
- laboratory: hours
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 108 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): Genetics TTBME0130_EN

Further courses built on it:-

Topics of course

History of gene manipulation with the emphasis on basic molecular biology technics.
Vectors, transformation technics, transgenic animals and plants. Pharming and gene therapy.
Prokaryote and eukaryote genomics: comparative and structural genomics, genomics in science and in everyday life.

Literature

Compulsory: Principles of gene manipulation and genomics. S.B. Primrose and R.M Twyman, Blackwell Publishing, 2013. Principles of genome analysis and genomics. S.B. Primrose and R.M Twyman, Blackwell Publishing, 2013.
Recommended: Gene cloning and Genomics, Ravishankar B.V, Laxmi Book Publication, 2017.

Schedule:

1st week: Basic techniques. Cutting and joining DNA molecules.

2nd week: Basic biology of plasmid and phage vectors.

3rd week: Cosmids, phasmids, and other advanced vectors. Gene-cloning strategies. Sequencing genes and short stretched of DNA.

4th week: Changing genes: site-directed mutagenesis and protein engineering.

5th week: Cloning in bacteria *Escherichia coli*. Cloning in yeast *Saccharomyces cerevisiae.*

6th week: Gene transfer to animal cells. Genetic manipulation of animals.

7th week: Gene transfer to plants. GMO plants.

8th week: Advanced transgenic technology. Applications of recombinant DNA technology.

9th week: The organization and structure of genomes.

10th week: Mapping and sequencing genomes.

11th week: Comparative genomics of prokaryotes, organelles and eukaryotes. Other aspects of comparative genomics.

12th week: Mapping protein interactions.

13th week: Applications of genome analysis and genomics: understanding the basis of polygenic disorders and identifying quantitative trait loci.

14th week: Summary.

Requirements:

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

- *for a grade*

The course ends in a writing **examination**.

Score	Grade
0-59%	fail (1)
60-69%	pass (2)
70-79%	satisfactory (3)
80-89%	good (4)
90-100%	excellent (5)

Person responsible for course: Dr. Zsuzsa Antunovics, associate professor, PhD

Lecturer: Dr. Zsuzsa Antunovics, associate professor, PhD

Title of course: **Cell cycle and epigenetics seminar** **Code**: TTBMG1130_EN	**ECTS Credit points:** 2

Type of teaching, contact hours
- lecture: -
- seminar: 2 hours/week
- laboratory: -

Evaluation: presentation and test

Workload (estimated), divided into contact hours:
- lecture: -
- seminar: 28 hours
- laboratory: -
- home assignment: 12 hours
- preparation for the test: 24 hours

Total: 64 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Cell cycle events in eukaryotes are highly important and understanding the regulation in particular can contribute to the development of therapeutic agents against cancer. In this seminar we discuss mitotic cell division and the regulation of cell cycle, including the regulation of Start point, G2/M and metaphase/anaphase transitions. Also we talk about some aspects of differentiation and cancer development. Since epigenetics is a quite new field, more and more interesting results emerge how these epigenetic processes contribute to cell cycle regulation, differentiation and cancer development. During the classes we discuss miRNAs, CpG island DNA methylation and histone code epigenetic phenomena and their role in health and cell cycle. Also some experimental techniques will be explained to understand how these processes can be analyzed. Presentations must be given by the students.

Literature

Compulsory:
- List of keywords sent out. Seminar materials sent out. Seminar notes taken during classes.

Recommended:
- C. David Allis et al.: Epigenetics, Second Edition; ISBN 978-1-936113-59-0.
- Coutts, Amanda S., Weston, Louise Cell Cycle Oscillators ISBN 978-1-4939-2957-3
- Eishi Noguchi and Mariana C. Gadaleta Cell Cycle Control 978-1-4939-0887-5

Schedule:

1st week: Introduction: epigenetics as a scientific field; a historical overview.

2nd week: Review of the structure of DNA and chromatin. Review of basic cell cycle events and regulation.

3rd week: Epigenetic events I: DNA methylation and de-methylation.

4th week: Epigenetic events II: Changes in the histone code.

5th week: Epigenetic events III: micro and small interfering RNAs in epigenetic regulation. The phenomenon of gene silencing.

6th week: Epigenetics and cell cycle interaction I: the basics.

7th week: The Epigenetics and cell cycle interaction II: tumor genesis.

8th week: Epigenetics and development. Developmental disorders.

9th week: Epigenetic changes in adults: our DNA sequence is not definitely our fate.

10th week: Epigenetics in medicine: diagnostics and treatments.

11th week: Review of studies, discussing further questions. Choosing the presentation materials.

12th week: Presentations and discussion I

13th week: Presentations and discussion II

14th week: End of semester test

Requirements:

- *for a signature*

Attendance at the seminars is compulsory.

- *for a grade*

An end of semester test will be written and a 5-10 minutes presentation will be required. Presentation must be accepted. The grade will be given based on the test as follows:

Percentage	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Gyula Batta, assistant professor, PhD

Lecturer: Dr. Gyula Batta, assistant professor, PhD

Title of course: **Bioregulation and Proteomics** **Code**: TTBME1130_EN	**ECTS Credit points: 1**

Type of teaching, contact hours

- lecture: 2 hours/week
- practice:
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:

- lecture: 28 hours
- practice: 0 hours
- laboratory: -
- home assignment: hours
- preparation for the exam: 60 hours

Total: 60 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s):

Further courses built on it: -

Topics of course

Bioregulation at the molecular and at the cellular levels. Regulation of the energy charge and the catabolic/anabolic reduction charge of the cell. Hormonal regulation: sensing the environment in multicellular eukaryotic organisms. The interplay between metabolic and signaling pathways through heterotrimer G-protein coupled receptors and through insulin receptor. The phosphatidylinositol signaling. Ras-MAP kinase pathway. The complexity of the proteome. The different types of proteomics and their characterization.

Literature

Compulsory:

- lecture notes

Recommended:

- Gerhard Krauss: Biochemistry of Signal Transduction and Regulation (Wiley-VCH Verlag GmbH & Co. KGaA, 2014), ISBN:9783527333660.
-Albert B., Bray D. Essential Cell Biology Fourth edition, Garland Science 2014 ISBN : 978-0-8153-4454-4.
- Nelson D.L., Cox M.M.: Lehninger Principles of Biochemistry (W. H. Freeman Sixth edition, 2012) ISBN-13: 978-14234146
-Nawin Mishra: Introduction to proteomics, Principles and application. (Wiley, 2010), ISBN: 978-0-471-75402-2.

Schedule:

1st week: Regulation at the cell level. Contribution of membrane proteins to the homeostasis of the cell. Processes that are sensititve to the energy charge and the catabolic/anabolic reduction charge of the cell.

2nd week: Regulation at the molecular level. Evolution of globin genes. Oxygen sensing mechanism in human erythrocytes. Expression of different human hemoglobin genes in human development. Methemoglobin reduction pathways. Hemoglobin and nitric oxide.

3rd week: Redox homeostasis of the cell.

4th week: The reception and transmission of extracellular information hormons and signal transduction pathway The overview of signal transduction pathways. Classification of receptors and signal molecules. The receptor-ligand interactions.

5th week: The G protein signal cascade. The structure of the seven transmembrane helix receptors and the heterotrimeric G proteins. The G protein cycle. Synthesis of cyclic AMP. Signal termination. Bacterial toxins target G proteins. Classification of G proteins and their physiological effects.

6th week: Physiological effect of Glucagon and ephinephrine. Adrenergic receptor subtypes and their coupled G proteins and effectors.

7th week: The role of G-Protein coupled receptors in sensory perception. Signals which change the resting membrane potential of the nerve cells. Sensory transduction in vision. Signaling by olphactory receptor neurons.

8th week: Signal cascades based on the membrane lipid phosphatidylinositol. The domain structures of PLC and PKC and their function. The role of Ca^{2+} in regulation.

9th week: Insulin signaling cascade. Processing and secretion of insulin. Insulin receptor and its tyrosine kinase activity. The role of SH2 domain. The activation of protein kinase B and the Glut4 translocation. Diabetes Mellitus and hyperglycemia.

10th week: Signaling through small GTP-binding proteins. Ras-MAP kinase pathway. Crosstalk among different Signaling Pathways.

11th week: Describing the complexity of the proteome. Protein domain functions and interactions.

12th week: Proteomics approach to protein expression profiling. Methods for proteomics separation and isolation of proteins. Proteomics of post-translationally modified proteins: phosphorylation, glycosylation.

13th week: Acquisition of protein structure information: Edman sequencing and mass spectrometry. Approach to quantitative proteomics. Protein arrays.

14th week: Functional proteomics. Mapping and Characterizing protein-protein interections in vivo and in vitro methods.

Requirements:

- for a signature
Attendance at **lectures** is recommended, but not compulsory.

- for a grade
The course ends in an **examination**.

The grade for the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)

70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Teréz Barna, PhD, assistant professor

Lecturer: Dr. Teréz Barna, PhD, assistant professor

Title of course: **Plant cell and developmental biology** **Code**: TTBME0700_EN, TTBML0700_EN	**ECTS Credit points: 3+2**

Type of teaching, contact hours
- lecture: 3 hours/week
- practice: -
- laboratory: 2 hours/week

Evaluation: examination

Workload (estimated), divided into contact hours:
- lecture: 42 hours
- practice: -
- laboratory: 28 hours
- home assignment: -
- preparation for the exam: 40 hours

Total: 110 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

Cytoskeleton and chromatin in plants. The mechanisms of sister chromatin segregation. The interactions between plant endomembranes with special emphasis on ER, mitochondria, plastids and peroxisomes.Signaling events in plant development including: embryogenesis, root, shoot and flower. The practical classes involve mainly modern techniques of microscopy, basic methods of histochemistry and immunohistochemistry and techniques for the analysis of subcellular structures in living plant cells. Regarding developmental biology, the students will learn how to study plant morphogenesis via tissue culture techniques.

Literature

Compulsory:
- Buchanan BB, Gruissem W, Jones RL, eds. (2000, 2015) Biochemistry and Molecular Biology of Plants. Blackwell-ASPB Books.

Recommended:
- Jones R, Ougham H, Thomas H, Waaland S, eds. (2013) The molecular life of plants. Wiley-Blackwell
- Fosket DE, Morejohn, LC (1992) Structural and functional organization of tubulin. Annu. Rev. Plant Physiol. Plant Mol. Biol. 43: 201-240.

Schedule:

Week 1

Lecture: General informations. A survey of the general and specific functions of the plant cell as learned during the BSc courses.

Practical: Short presentation of the basic methods that will be used during the semester.

Week 2

Lecture: The endomembrane system of plant cells and its dynamics. ER, Golgi, peroxisomes,

plant vacuoles. Structure and functioning of the tonoplast.
Practical: Detection of endomembranes in living plant cells.

Week 3
Lecture: The plastid system. Structure and dynamics of plastids, their structural and functional relationships with other cell compartments. Division of plastids, its molecular mechanisms.
Practical: Visualization of plastid division in living cells.

Week 4
Lecture: Dynamics of subcellular structures, the role of cytoskeleton and endomembranes in intracellular movement in plant cells. Microtubules, microfilaments. Discussion of the topics presented at the lecture.
Practical: Modern techniques related to the study of intracellular dynamics. Immunohistochemistry for the detection of microtubules in root meristematic cells.

Week 5
Lecture: The role of cytoskeleton in the division, differentiation and shape determination of plant cell. Discussion of the topics presented at the lecture. Mitosis and cytokinesis in higher plants.
Practical: Visualization of microfilaments in fixed and living plant cells.

Week 6
Lecture: The mechanisms of sister chromatid segregation in mitotic cells. The cytoskeleton-kinetochore relationship. General features and particularities of plant cells. Discussion of the topics presented at the lecture.
Practical: Methods for chromatin labeling in plant cells.

Week 7
Lecture: The regulation of plant cell cycle. Molecular mechanisms and particularities for plant cells regarding the role of cytoskeleton and regulation by plant growth regulators. Discussion of the topics presented at the lecture.
Practical: Methods for the labeling of subcellular structures in mitotic plant cells.

Week 8
Lecture: Embryogenesis in vascular plants. A survey of the process and molecular/genetic mechanisms of its regulation. Discussion of the topics presented at the lecture.
Practical: Induction of somatic embryogenesis and observation of embryos in plant tissue cultures.

Week 9
Lecture: Root and shoot development in vascular plants. The regulation of meristemal identity. A survey of the process and molecular/genetic mechanisms of its regulation. Discussion of the topics presented at the lecture.
Practical: Shoot development: observation of the shoot tip meristem in the aquatic plant *Ceratophyllum demersum*.

Week 10
Lecture: Flower development in vascular plants. The regulation of floral meristem identity. A survey of the process and molecular/genetic mechanisms of its regulation. Discussion of the topics presented at the lecture.
Practical: The induction of shoot development in tissue cultures.

Week 11
Lecture: Phylogenetic outlook: the evolution of root and shoot structures I.. Discussion of the topics presented at the lecture.
Practical: The induction of root development in tissue cultures.

Week 12

Lecture: Phylogenetic outlook: the evolution of root and shoot structures II. Discussion of the topics presented at the lecture.
Practical: Plant regeneration from somatic embryos.

Week 13
Lecture: Phylogenetic outlook: the evolution of flower structures. Discussion of the topics presented at the lecture.
Practical: Modern methods for the study of flower development: discussion forum.

Week 14
Consultation: a survey of the work performed during the semester.

Requirements:

Lectures:

- *for a signature*
Attendance at **lectures** is recommended, but not compulsory.

- *for a grade*
The course ends in an **examination** in case of the lecture.

Practical:

Participation at the practicals is compulsory. The mark for laboratory grade consists of the activity shown during the semester and the results of two (mid-term and end-term) tests.

The minimum requirement for both the examination and laboratory grade is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade:
it may be offered for students if the average grade of the designing tasks is at least satisfactory (3)

Person responsible for course: Dr. Csaba Máthé, associate professor, PhD

Lecturer: Dr. Csaba Máthé, associate professor, PhD

Title of course: **Plant genetics and biotechnology** **Code**: TTBME0710_EN, TTBMG0710_EN	**ECTS Credit points: 2+2**
Type of teaching, contact hours - lecture: 2 hours/week - seminar: 2 hours/week - laboratory: 0 hours/week	
Evaluation: examination	
Workload (estimated), divided into contact hours: - lecture: 28 hours - seminar: 28 hours - laboratory: - - home assignment: - - preparation for the exam: 40 hours Total: 96 hours	
Year, semester: 2nd year, 1st semester	
Its prerequisite(s): -	
Further courses built on it: -	

Topics of course

The plant genomes – structure and operation. Prokaryotic and eukaryotic gene expression in plant cells. The regulation levels of plant gene expression. Genetic and epigenetic regulation of plant metabolism, development and growth. Plant protein metabolism and post-translational modification of proteins. Forming of transgenic plants: methods and technology. Main applications of GMO plants.

Literature

Compulsory:
Jones R, Ougham H, Thomas H, Waaland S, eds. The molecular life of plants. Wiley-Blackwell 2013

Recommended:
1.) Plant Biotechnology - New Products and Applications
J. Hammond, P. McGarvey and V. Yusibov Eds.
Springer-Verlag Berlin Heidelberg 2000.

2.) Thin Cell Layer Culture System – Regeneration and Transformation Applications
D.T. Nhut, B.V. Le, K.T. T. Van and T. Thorpe Eds.
Kluwer Academic Publishers, Netherlands 2003.

3.) Introduction to Plant Tissue Culture
M. K. Razdan
Science Publishers, Inc., Plymouth, UK

Schedule: -

Requirements:

Lectures:

- *for a signature*

- *for a grade* **Seminar: -** *-an offered grade:*
Person responsible for course: Dr. Gyula Surányi, assistant professor, CSc
Lecturer: Dr. Gyula Surányi, assistant professor, CSc; Dr. Csaba Máthé, associate professor, PhD; Dr. Márta Hamvas, associate professor, PhD,; Dr. Viktor Oláh, assistant professor, PhD

Title of course: **Molecular plant taxonomy** **Code**: TTBME0905_EN, TTBML0905_EN	**ECTS Credit points: 2+2**

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 42 hours
- practice: 28 hours
- laboratory: -
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 150 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

This course will introduce the student to molecular phylogenetic methods in plants and their application to taxonomic studies. It gives an overview about the most important topics in plant molecular phylogenetics with an emphasis on taxonomic and conservation genetics implications. It will also use these information to introduce the students to modern plant taxonomy based on, not exclusively, molecular results. The course will also describe the most important DNA-fingerprinting methods and sequencing approaches with an emphasis on genomic methods. Finally, we will touch the issue of phylogeography, the distribution of genetic variation in geographic space.

Literature

Compulsory:

Salemi M & Vandamme AM (2003, szerk.) The phylogenetic handbook: a practical approach to DNA and protein phylogeny. 2nd Edition. Cambridge University Press, Cambridge.

Lowe A, Harris S & Ashton P (2004) Ecological genetics: design, analysis, and application. John Wiley & Sons, Oxford.

Recommended:

Soltis D, Soltis P, Endress P, Chase MW, Manchester S, Judd W, Majure L, Mavrodiev E. 2018. Phylogeny and Evolution of the Angiosperms: Revised and Updated Edition: University of Chicago Press.

Schedule:

1st week: Introduction to plant molecular taxonomy. The role of neutral mutations in the study of evolutionary and population genetic processes.

2nd week: Studies of plant genetic diversity at the level of populations and above the species rank. Question-specific sampling strategies.

3rd week: Basic molecular techniques: DNA-fingerprinting I. RAPD, RFLP, AFLP.

4th week: Basic molecular techniques: DNA-fingerprinting II. ISSR, SSR

5th week: Basic molecular techniques: DNA-sequencing: Sanger-sequencing. NGS.

6th week: Analytical methods of DNA-fingerprinting data. Tree building based on genetic distance.

7th week: The usage of minisatellites and microstaellites in population genetics of plants.

8th week: Analytical methods of DNA-sequencing data. Phylogenetic tree reconstruction. Cladograms vs. phylograms.

9th week: The role of hybridisation and incomplete lineage sorting in the study of evolutionary history of plants. Paralogy and orthology in gene sequences.

10th week: Candidate genes in plant phylogenetics and phylogeography.

11th week: The properties of nrITS for the study of plant phylogenetics.

12th week: Next-generation sequencing (NGS) techniques. The nature of NGS data.

13th week: Generation and analysis of NGS data.

14th week: Homology assessment in NGS data. Phylogenetic tree reconstruction based on NGS data.

Requirements:

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behaviour or conduct does not meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two **mid-semester tests**: one can be expected during mid-term and one at the end-term. **Students have to sit for the tests at the practice class.**

- *for a grade*

The course ends with an **examination**. Based on the average of the grades of the mid-semester tests and the examination, the exam grade is calculated as a weighted average of them:

1. the average grade of the two mid-semester tests
2. the result of the examination weighted three-times.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)

60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retrial in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Gábor Sramkó, postdoctoral researcher, PhD

Lecturer: Dr. Gábor Sramkó, postdoctoral researcher, PhD

Title of course: **Conservation biology** **Code**: TTBME0510_EN	**ECTS Credit points:** 1
Type of teaching, contact hours - lecture: 1 hour/week - practice: 0 hours/week - laboratory: -	
Evaluation: exam	
Workload (estimated), divided into contact hours: - lecture: 14 hours - practice: - - laboratory: - - home assignment: - - preparation for the exam: 40 hours Total: 54 hours	
Year, semester: 1st year, 2nd semester	
Its prerequisite(s): -	
Further courses built on it:-	
Topics of course	
The science of conservation biology and related disciplines. Theoretical background and history and conservation biology. Distribution of biodiversity on Earth, biodiversity hotspots. Factors threatening biodiversity. Ecological economics, ecosystem services and functions. Invasive species and related conservational problems. Tools for invasion control. Habitat loss and degradation. Isolation, fragmentation, landscape-scale loss of biodiversity. Planning conservation areas, buffer zones, and ecological corridors. Basics of population conservation, minimum viable population. Species conservation programs and action plans. Nature conservation management, conservation of grassland biodiversity. Restoration ecology and ecological restoration. Theoretical background of the planning and monitoring of landscape-scale restoration projects. Legislation of nature conservation, international conventions.	
Literature	
Compulsory: Primack, R. B. 2014: Essentials of Conservation Biology, Oxford University Press. *Recommended:* Groom, M.J., Meffe, G.K., Carrol, C.R. 2006. Principles of Conservation Biology. 3rd Edition. Sinauer Associates, Inc. Sunderland	
Schedule: *1st week:* Introduction to the course. *2nd week:* The science of conservation biology and related disciplines. Theoretical background and history and conservation biology. *3rd week:* Distribution of biodiversity on Earth, biodiversity hotspots. Factors threatening biodiversity. *4th week:* Ecological economics, ecosystem services and functions. *5th week:* Invasive species and related conservational problems. Tools for invasion control.	

6th week: Habitat loss and degradation. Isolation, fragmentation, landscape-scale loss of biodiversity.

7th week: Mid-term exam.

8th week: Planning conservation areas, buffer zones, and ecological corridors.

9th week: Basics of population conservation, minimum viable population. Species conservation programs and action plans.

10th week: Nature conservation management, conservation of grassland biodiversity.

11th week: Restoration ecology and ecological restoration.

12th week: Theoretical background of the planning and monitoring of landscape-scale restoration projects.

13th week: Legislation of nature conservation, international conventions.

14th week: End-term exam

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

Person responsible for course: Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török,

professor, DSc,
Lecturer: Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török, professor, DSc,

Title of course: **Conservation biology seminar** **Code**: TTBMG0510_EN	**ECTS Credit points:** 2

Type of teaching, contact hours
- lecture: 0 hours/week
- seminar: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- seminar: 28 hours
- laboratory: -
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 108 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it:-

Topics of course

Anthropogenic factors threatening biodiversity, the biodiversity crisis. Invasive species and related conservational problems. Tools for invasion control. Habitat loss and degradation. Isolation, fragmentation, landscape-scale loss of biodiversity. Planning conservation areas, buffer zones, and ecological corridors. Basics of population conservation, minimum viable population. Species conservation programs and action plans. Nature conservation management, conservation of grassland biodiversity. Restoration ecology and ecological restoration. Planning and monitoring of landscape-scale restoration projects.

Literature

Compulsory:
Primack, R. B. 2014: Essentials of Conservation Biology, Oxford University Press.
Recommended:
Groom, M.J., Meffe, G.K., Carrol, C.R. 2006. Principles of Conservation Biology. 3rd Edition. Sinauer Associates, Inc. Sunderland

Schedule:

1st week: Introduction to the course.

2nd week: Consultation lesson. Discussing the sub-topics of the course and the literature search for the sub-topics for each student.

3rd week: Student presentations of the first sub-topic (Anthropogenic factors threatening biodiversity, the biodiversity crisis) and discussion.

4th week: Student presentations of the second sub-topic (Invasive species and related conservational problems. Tools for invasion control) and discussion.

5th week: Student presentations of the third sub-topic (Habitat loss and degradation) and discussion.

6th week: Consultation lesson. Discussing the sub-topics of the course and the literature search for the sub-topics for each student.

7th week: Student presentations of the fourth sub-topic (Isolation, fragmentation, landscape-scale loss of biodiversity) and discussion.

8th week: Student presentations of the fifth sub-topic (Planning conservation areas, buffer zones, and ecological corridors) and discussion.

9th week: Student presentations of the sixth sub-topic (Basics of population conservation, minimum viable population) and discussion.

10th week: Consultation lesson. Discussing the sub-topics of the course and the literature search for the sub-topics for each student.

11th week: Student presentations of the seventh sub-topic (Species conservation programs and action plans) and discussion.

12th week: Student presentations of the eighth sub-topic (Nature conservation management, conservation of grassland biodiversity) and discussion.

13th week: Student presentations of the ninth sub-topic (Restoration ecology and ecological restoration. Planning and monitoring of landscape-scale restoration projects) and discussion.

14th week: Consultation lesson.

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester all students have to present a short lecture (with Power Point presentation) about a chosen topic in the field of conservation biology.

The grade for the presentation is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török, professor, DSc,

Lecturer: Prof. Dr. Béla Tóthmérész, professor, DSc,; Prof. Dr. Péter Török, professor, DSc,

Title of course: **Plant Ecology** **Code**: TTBME0600_EN	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 0 hours/week
- laboratory: 0 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 14 hours
- laboratory: 0 hours
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 94 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The course introduce the relationship between the plants and their abiotic and biotic environment. It provide essential information on plant population biology, life cycle and its most remarkable stages like seed dispersal, dormancy, germination and plant establishment. It introduce the most important type of positive and negative interactions between plant populations. The course provide information on the adaptation mechanisms of plants to different types of the abiotic environment. It also summarise current knowledge of spatial vegetation dynamics and succession.

Literature

- Begon, M., Harper, J. L. et Towsend, C. R. 1986: Ecology, Blackwell Scientific Publications, pp. 877, 4th Edition - 2004.
- Harper, J. L. 1977: Population Biology of Plants, Academic Press, London, pp. 829.
- Thompson, K. et Fenner M. 2005: Seed Ecology, Cambridge University Press, Cambridge, pp. 250.

Schedule:

1st week: The history of plant ecology

2nd week: The plant life cycle I – Species dispersal

3rd week: The plant life cycle II – Dormancy and germination

4th week: The plant life cycle III – Essentials of plant reproduction

5th week: Types of interactions between populations I – Positive interactions

6th week: Types of interactions between populations I – Negative interactions

7th week: Plant life strategies

8th week: Plant traits and trait based ecology

9th week: Environmental factors affecting plant life I - Climate

10th week: Environmental factors affecting plant life I – Edaphic and relief factors

11th week: Essentials of plant community ecology

12th week: Applied Plant ecology I

13th week: Applied Plant ecology II

14th week: End-term test

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

Person responsible for course: Prof. Dr. Péter Török, professor, DSc.

Lecturer: Prof. Dr. Péter Török, professor, DSc.

Title of course: **Plant ecology seminar** **Code**: TTBMG0600_EN	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 2 hours/week
- laboratory: 0 hours/week

Evaluation: practical grade

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 28 hours
- laboratory: 0 hours
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 108 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The course provide the students the most important knowledge in research planning, experimental research and introduce the most important field methods of data collection in plant ecology. The course focus on methods frequently used in assessment and evaluation focusing on essential sampling methods of vegetation coverage and height, biomass, soil seed bank or sampling of water plants and algae. The course provide knowledge on data collection and basic analysis and representation tools in data analyses and recording. The course introduce the theory of trait-based ecosystem analyses, provide information of trait measurements and analyses, and provide essential guideline for trait-based ecosystem engineering and ecological strategies based analyses in environmental sciences

Literature

- Moore PD and Chapman SB (1986): Methods in plant ecology. Blackwell Scientific Publications, Oxford.
- Martin Kent, Paddy Cooker (1995): Vegetation description and analysis – A practical approach. Wiley, Chichester.
- Gordon A. Fox, Simonetta Negrete-Yankelevich, Vinicio J. Sosa (eds.) (2015): Ecological Statistics – Contemporary theory and application. Oxford University Press, Oxford.

Schedule:

1st week: Introduction to the course

2nd week: Field measurement methods in plant ecology I

3rd week: Field measurement methods in plant ecology II

4th week: Qualitative variables of the plant community I

5th week: Qualitative variables of the plant community II

6th week: Biomass harvest in plant communities

7th week: Non-destructive assessments of community biomass

8th week: Seed bank sampling and analysis

9th week: Measuring freshwater communities I

10th week: Measuring freshwater communities II

11th week: Plant traits and their measurement in field and laboratory

12th week: Essentials of data capture and analysis

13th week: Field experimentation and research planning

14th week: End-term test

Requirements:

Participation at classes is compulsory. A student must attend the courses and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

it may be offered for students if the average grade of the two designing tasks is at least satisfactory (3) and the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

- in case an offered grade cannot be given, or it is not convenient for the student there is a possibility to have an exam in the exam session

Person responsible for course: Prof. Dr. Péter Török, professor, DSc.

Lecturer: Prof. Dr. Péter Török, professor, DSc.

Title of course: **Animal ecology lecture** **Code**: TTBME0605_EN	**ECTS Credit points:** 1

Type of teaching, contact hours
- lecture: 2 hours/week
- practice: -
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 28 hours
- practice:
- laboratory: -
- home assignment: 40 hours
- preparation for the exam: 40 hours

Total: 108 hours

Year, semester: 1st year, 1st semester

Its prerequisite(s):

Further courses built on it: -

Topics of course

The aim of the course is to introduce animal ecology. The course gives knowledge about the effects of temperature, light, radiation and salt content on animal population, the population dynamics of predation, parasitism, symbiosis and mutualism, decomposers and detritivores, intra- and interspecific competition.

Literature

Compulsory:

Begon M, Harper JL, Townsend CR. Ecology. From Individuals to Ecosystems. Blackwell Scientific Publications, Oxford, 1986.

Molles MC. Ecology: Concepts and Applications. 7th Edition. McGraw-Hill Education. 2016

Recommended:

Leibold MA, Wootton TJ. Animal Ecology. University of Chicago Press. 2001.

Schedule:

1st week: Introduction of course.

2nd week: Effects of temperature on animal population.

3rd week: Effects of light and radiation on animal population.

4th week: Population dynamics of symbiosis and mutualism.

5th week: Population dynamics of predation.

6th week: Population dynamics of parasitism.

7th week: Mid-term test.

8th week: Population dynamics of decomposers.

9th week: Population dynamics of detritivores.

10th week: Population dynamics of decomposers intraspecific competition.

11th week: Population dynamics of decomposers interspecific competition.

12th week: Migration and dispersion in animal population.

13th week: Life history strategies of animal population.

14th week: End-term test.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week. Students have to sit for the tests.

- for a grade

3. The course ends in an **examination**.

The minimum requirement for the mid-term and end-term tests and the examination respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

-an offered grade:

the average of the mid-term and end-term tests is at least satisfactory (3). The offered grade is the average of them.

Person responsible for course: Dr. Edina Kundrát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

Lecturer: Dr. Edina Kundrát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

Title of course: **Animal ecology seminar** **Code**: TTBMG0605_EN	**ECTS Credit points:** 2
Type of teaching, contact hours - lecture: - seminar: 2 hours/week - laboratory: -	
Evaluation: exam	
Workload (estimated), divided into contact hours: - lecture: - seminar: 28 hours - laboratory: - - home assignment: 40 hours - preparation for the exam: 40 hours Total: 108 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s):	
Further courses built on it: -	
Topics of course	
The aim of the course is to introduce the field and laboratory methods of animal ecology. The course gives knowledge about the methods of the soil and water sampling, the methods of analyses of soil and water, important physical and chemical parameters, field methods for the study of animal population: visual, acoustic, trapping and other sampling methods.	
Literature	
Compulsory: Begon M, Harper JL, Townsend CR. Ecology. From Individuals to Ecosystems. Blackwell Scientific Publications, Oxford, 1986. Molles MC. Ecology: Concepts and Applications. 7th Edition. McGraw-Hill Education. 2016 *Recommended:* Leibold MA, Wootton TJ. Animal Ecology. University of Chicago Press. 2001.	
Schedule: *1st week:* Introduction of course. *2nd week:* Methods of soil and water sampling in field. *3rd week:* Analyses of soil physical parameters. *4th week:* Analyses of soil chemical parameters. *5th week:* Analyses of water physical parameters. *6th week:* Analyses of water chemical parameters. *7th week:* Analyses of morphological parameters of invertebrates.	

8th week: Visual field methods.

9th week: Acoustic field methods.

10th week: Trapping field methods.

11th week: Other sampling methods.

12th week: Preparation methods.

13th week: Identification methods.

14th week: End-term test.

Requirements:

- for a signature

Participation at **seminar classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any seminar with another group. Attendance at seminar classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two tests: the mid-term test in the 7th week and the end-term test in the 14th week. Students have to sit for the tests.

- for a grade

The minimum requirement for the mid-term and end-term tests respectively is 60%. Based on the score of the tests separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Edina Kundrát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

Lecturer: Dr. Edina Kundrát-Simon, associate professor, PhD, habil; Roland Horváth, assistant professor, PhD

Title of course: **Biometry** **Code**: TTBML0300_EN	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 0 hours/week
- laboratory: 4 hours/week

Evaluation: written exam

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 0 hours
- laboratory: 56 hours
- home assignment: 0 hours
- preparation for the exam: 40 hours

Total: 106 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s):

Further courses built on it:

Topics of course

Introduction to the R Statistical Environment. Data handling. Descriptive statistics. Statistical hypotheses. Statistical tests on group means. Non-parametric statistics. Statistical tests for variances and distributions. Analysis of variance. Testing the relationships between continuous variables. Linear regression and correlation. Analysis of covariance. Multivariate statistical models. Model selection. Checking model assumptions. Generalized Linear Models. Linear Mixed models. Principal Components Analysis.

Literature

Sokal RR. & Rohlf FJ. 1981. Biometry. W.H. Freeman, New York.

Schedule:

1st week: Introduction to the R Statistical Environment.

2nd week: Data handling.

3rd week: Descriptive statistics.

4th week: Statistical hypotheses. Statistical tests on group means.

5th week: Non-parametric statistics. Statistical tests for variances and distributions.

6th week: Analysis of variance.

7th week: Testing the relationships between continuous variables. Linear regression and correlation.

8th week: Analysis of covariance.

9th week: Multivariate statistical models.

10th week: Model selection.

11th week: Checking model assumptions.

12th week: Generalized Linear Models.

13th week: Linear Mixed models.

14th week: Principal Components Analysis.

Requirements:

Participation at the classes is compulsory. A student may not miss more than three lectures during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

The minimum requirement for the exam 60%. Grades are given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Jácint Tökölyi, assistant professor, PhD

Lecturer: Dr. Jácint Tökölyi, assistant professor, PhD

Title of course: **Research planning** **Code**: TTBML0305_EN	**ECTS Credit points: 2**

Type of teaching, contact hours

- lecture: 0 hours/week
- practice: 0 hours/week
- laboratory: 2 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:

- lecture: 0 hours
- practice: 0 hours
- laboratory: 28 hours
- home assignment: 20 hours
- preparation for the exam: 20 hours

Total: 68 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): Biometry TTBML0300_EN

Further courses built on it: Field practical TTBML0310_EN, Project evaluation and review TTBML0315_EN

Topics of course

The goal of this course is that students can learn the essential steps required to plan a successful research project. This course is part of a complex that is comprised of three classes spanning over two semesters. The first part is the current course, in which the students will prepare a detailed, written research plan for a field research project that they will carry out in the following semester (Field trip). Following data collection in the field, in the final, third part of the curriculum, they will analyse the results, and write up a research paper that meets the formal requirements of a scientific publication. After that, students will practice peer-review by evaluating their peers' work. This set of courses make it an excellent opportunity to train students about every part of a scientific investigation from planning up to the publication of the results and critical evaluation of others' work.

Thematic of the current course:
Parts of the scientific investigations. The scientific method, positivism and the hypothetico-deductive approach. Generating hypotheses and making predictions. Experimental designs, sampling protocols with an emphasis on field methods. Standardization and randomization. Observer bias and the importance of blinding. Requirements of a research plan.

Literature

Compulsory:

4. course material

Recommended:

- Gerry P. Quinn, Michael J. Keough. 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.

Schedule:

1st week: The scientific method. Generating hypotheses and drawing predictions.

2nd week: Approaching a new scientific question. How to survey the literature.

3rd week: Choosing study subjects, area and methodology

4th week: Principles of data collection: sampling designs, difference between experimental and observational studies.

5th week: Controlling for confounders. Spurious correlations.

6th week: Experimental protocols. Randomization, standardization, the importance of a control group. Blinding.

7th week: Experimental protocols. Randomized block design, Latin square, factorial design.

8th week: Analysing collected data - 1. Continuous variables.

9th week: Analysing collected data – 2. Comparing groups.

10th week: Analysing collected data – 3. Other methods.

11th week: Organizing research data. Data structures and reproducible research.

12th week: Writing up: structure of scientific communications (talks, posters and papers).

13th week: Publishing: from manuscript submission to peer review.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at practice classes will be recorded by the practice leader In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

During the semester there are two assignments: a mid-term assignment in the 8th week and the end-term assignment in the 15th week. Students have to turn in the assignments.

- for a grade

The course ends in an **examination**. Based on the average of the grades of the assignment tasks and the examination, the exam grade is calculated as an average of them:

4. the average grade of the two designing tasks
5. the result of the examination

The minimum requirement for the mid-term and end-term assignments and the examination respectively is 60%. Based on the score of the assignments separately, the grade for the tests and the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Adam Z Lendvai, associate professor, PhD

Lecturer: Dr. Adam Z Lendvai, associate professor, PhD

Title of course: **Field practical** **Code**: TTBMG0310_EN	**ECTS Credit points: 3**

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 0 hours/week
- laboratory: 3 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 0 hours
- laboratory: 42 hours
- home assignment: 26 hours
- preparation for the exam: 0 hours

Total: 68 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s): Research planning TTBML0305_EN

Further courses built on it: Project evaluation and review TTBML0315_EN

Topics of course

This is a one week long field trip during which students will carry out the research plan that they prepared in the previous semester. During the field, students are faced with the feasibility of their plan and will learn practical details of the field methods. At the end of the field course, we discuss what they have learnt and the students are required to present the data that they collected and preliminary analyses.

Literature

Compulsory: -
Recommended: -

Schedule:
This is a one week long field course.

Requirements:

- for a signature
Participation at **practice classes** is compulsory. A student must attend the field course and since it is organized in the field, attendance cannot be partial.

- for a grade
The course ends in an **evaluation** of how well the student performed the required tasks during the field course. The grade for evaluation is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

Person responsible for course: Dr. Adam Z Lendvai, associate professor, PhD
Lecturer: Dr. Adam Z Lendvai, associate professor, PhD Dr Miklós Bán, assistant professor, PhD

Title of course: **Project evaluation and review** **Code**: TTBML0315_EN	**ECTS Credit points: 2**

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 0 hours/week
- laboratory: 2 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 0 hours
- laboratory: 28 hours
- home assignment: 40 hours
- preparation for the exam: 0 hours

Total: 68 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s): Research planning TTBML0305_EN

Further courses built on it:

Topics of course

In depth data analysis and presentation of the results collected during the field course. The evaluation of the presentations. Writing up a scientific report of the results meeting the formal requirement of a scientific publication. Performing peer review of the submitted manuscripts.

Literature

Compulsory: course material

Recommended: Joshua Shimel: Writing Science: How to Write Papers That Get Cited and Proposals That Get Funded. Oxford University Press
Edward J. Shewan 2007. Writing A Research Paper. Christian Liberty Press.

Schedule:

Students must independently work on the data collected during the field trip and then present their results as a form of a presentation, later as a written report and then provide critical feedback on their peers' work. Therefore the schedule of this class is nor organized by weeks, but there are an initial appointment at the beginning of the class, following by the presentation and the peer review.

Requirements:

- for a grade

Grade is given based on the following activities: (1) initial oral presentation (2) written research paper (3) peer review activity (4) submission of the revised paper. The grade for evaluation is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

-an offered grade:

Person responsible for course: Dr. Adam Z Lendvai, associate professor, PhD
Lecturer: Dr. Adam Z Lendvai, associate professor, PhD Dr Miklós Bán, assistant professor, PhD

Title of course: **Animal populations** **Code**: TTBME0320_EN	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 0 hours/week
- laboratory: 0 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 0 hours
- laboratory: 0 hours
- home assignment: 28 hours
- preparation for the exam: 28 hours

Total: 70 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s):

Further courses built on it: -

Topics of course

Basics of population growth. Exponential growth in population of identical individuals and in state structured populations. Control of population growth: density dependence. Methods to estimate population size: absolute and relative estimates. Survey methods: point and line transects. Capture-mark-recapture methods. Spatial distribution.

Literature

Compulsory:
Recommended:
Pásztor et al. 2017, Theory Based Ecology. Oxford University Press.
Łomnicki, A. 1988. Population Ecology of Individuals, Monographs in Population Biology 25. Princeton University Press, Princeton

Schedule:

1st week: Population dynamics. Birth and death rates.

2nd week: Exponential population growth. Examples for exponential growth.

3rd week: Computer simulation of exponential growth. Effects of parameters.

4th week: Estimation of growth parameters.

5th week: Exponential growth in structured populations.

6th week: Computer simulation of exponential growth in structure populations. Effects of parameters.

7th week: Consultations on exponential growth.

8th week: Limits of population growth. Environmental capacity, density dependence. Chaotic population dynamics.

9th week: Simulation of limited population growth. Effects of parameters.

10th week: Limited growth in structured populations.

11th week: Simulation of limited growth in structure populations.

12th week: Competitive exclusion.

13th week: Population dynamics and evolution.

14th week: Consultations on limited growth.

Requirements:

- for a signature

Attendance at **lectures** is recommended, but not compulsory.

- for a grade

The course ends in an **examination**. The grade for the examination is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Zoltan Barta, professor, PhD, DSc

Lecturer: Dr. Zoltan Barta, professor, PhD, DSc

Title of course: **Animal populations practical** **Code**: TTBML0320_EN	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 1 hours/week
- laboratory: 0 hours/week

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 14 hours
- laboratory: 0 hours
- home assignment: 28 hours
- preparation for the exam: 28 hours

Total: 70 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s):

Further courses built on it: -

Topics of course

During the practical the students will carry out two experiments. In one of them they maintain three colonies of Collembola and count the number of individuals in colonies. After gathering the data they analyse popuation growth. In the second experiment, they simulate capture-mark-recapture methodology to estimate the „population size" of rise.

Literature

Compulsory:

Recommended:

Krebs, C.J. 1989. Ecological methodology. Harper and Row, New York

Southwood, T.R.E. and P.A. Henderson 2000. Ecological methods. Blackwell

Schedule:

1st week: Introduction: sampling populations, sampling methods. Absolute and relative estimates of population size, population indices. Capture-recapture methods.

2nd week: Estimation population parameters for the sparrow population of the University Botanical Garden.

3rd – 5th week: Carry out the Botanical Garden sampling.

6th week: Analyses of Botanical Garden data.

7th week: Population growth in Collembola. Setup of Collembola colonies. Planning of sampling.

8th – 9th week: Measuring population growth in Collembola colonies.

10th week: Capture-recapture methods. Estimation of population "size" of rice.

11th week: Analysing “rice” population size data. *12th week:* Measuring population growth in Collembola. *13th week:* Analysing Collembola data. *14th week:* Consultations on population data analyses.
Requirements: - *for a signature* Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. - *for a grade* Students have to present two talks on the Botanical Garden data, “rice” data or Collembola data.
Person responsible for course: Dr. Zoltan Barta, professor, PhD, DSc
Lecturer: Dr. Zoltan Barta, professor, PhD, DSc

Title of course: **Animal behaviour lecture** **Code**: TTBME0325_EN	**ECTS Credit points:** 1

Type of teaching, contact hours
- lecture: 1 hours/week
- practice: 0 hours/week
- laboratory: -

Evaluation: exam grade

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 0 hours
- laboratory: -
- home assignment: 0 hours
- preparation for the exam: 30 hours

Total: 44 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s):

Further courses built on it: -

Topics of course

The goals of the course are (1) to provide an overview of the incredibly diverse behavioural patterns exhibited by both vertebrate and invertebrate organisms, and (2) to aid students in explaining the origin and function of these behaviours by using approaches guided by Tinbergen's four questions. Students will be exposed to various experimental design templates, data collection as well as statistical methods used in behavioural research. Moreover, students will get hands-on training in behavioural research by completing three small experiments. By the end of the course, students will be able to design their own behavioural research project, collect and evaluate their data to draw conclusions about their research questions or hypotheses.

Literature

Compulsory:

Course material

Recommended:

- Rubenstein, D., Alcock J. 2018. Animal Behaviour. Sinauer Associates.
- Martin P. & Bateson P. 1993. Measuring Behaviour. Cambridge University Press, Cambridge.
- Dawkins MS. 2007. Observing Animal Behaviour. Oxford University Press, Oxford.
- Danchin E., Giraldeau L.-A., Cézilly F. 2008. Behavioural Ecology. Oxford University Press, Oxford.

Schedule:

1st week: Introduction: studying behaviour using Tinbergen`s four questions (lecture).

2nd week: Observing and measuring behaviour: methods and techniques (practice).

3rd week: Grouping behaviour (lecture).

4th week: Grouping behaviour (practice).

5th week: Animal personality (lecture)

6th week: Animal personality: measuring individual differences in aggressive behaviour (practice).

7th week: Brood parasitism (lecture).

8th week: Brood parasitism (practice).

9th week: Social networks (lecture)

10th week: Social networks (practice)

11th week: Decision-making and individual preferences (lecture).

12th week: Decision-making and individual preferences (practice).

13th week: Cooperation: the use of game theoretical models in behavioural research (lecture and practice)

14th week: Consultation.

Requirements:

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to **submit all three lab reports** as scheduled minimum at a sufficient level. The average scores calculated from the three lab reports will produce the final practical grade. See grading table below.

The course ends in an **examination**. Exam grade is calculated based on the grading table below.

The minimum requirement for passing the examination and receiving an exam grade as well as a practical grade is 60%. The grade for the examination and the lab reports is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Zoltán Németh, PhD, assistant professor
Lecturers: Dr. Zoltán Németh, PhD, assistant professor, Prof. Dr. Tamás Székely, PhD, professor, Prof. Dr. Zoltán Barta, PhD, professor, Dr. Miklós Bán, assistant professor

Title of course: **Animal behaviour practice** **Code**: TTBML0325_EN	**ECTS Credit points:** 1

Type of teaching, contact hours
- lecture: 0 hours/week
- practice: 1 hours/week
- laboratory: -

Evaluation: practice grade

Workload (estimated), divided into contact hours:
- lecture: 0 hours
- practice: 14 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 0 hours

Total: 44 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s):

Further courses built on it: -

Topics of course

The goals of the course are (1) to provide an overview of the incredibly diverse behavioural patterns exhibited by both vertebrate and invertebrate organisms, and (2) to aid students in explaining the origin and function of these behaviours by using approaches guided by Tinbergen's four questions. Students will be exposed to various experimental design templates, data collection as well as statistical methods used in behavioural research. Moreover, students will get hands-on training in behavioural research by completing three small experiments. By the end of the course, students will be able to design their own behavioural research project, collect and evaluate their data to draw conclusions about their research questions or hypotheses.

Literature

Compulsory:

Course material

Recommended:

- Rubenstein, D., Alcock J. 2018. Animal Behaviour. Sinauer Associates.
- Martin P. & Bateson P. 1993. Measuring Behaviour. Cambridge University Press, Cambridge.
- Dawkins MS. 2007. Observing Animal Behaviour. Oxford University Press, Oxford.
- Danchin E., Giraldeau L.-A., Cézilly F. 2008. Behavioural Ecology. Oxford University Press, Oxford.

Schedule:

1st week: Introduction: studying behaviour using Tinbergen`s four questions (lecture).

2nd week: Observing and measuring behaviour: methods and techniques (practice).

3rd week: Grouping behaviour (lecture).

4th week: Grouping behaviour (practice).

5th week: Animal personality (lecture)

6th week: Animal personality: measuring individual differences in aggressive behaviour (practice).

7th week: Brood parasitism (lecture).

8th week: Brood parasitism (practice).

9th week: Social networks (lecture)

10th week: Social networks (practice)

11th week: Decision-making and individual preferences (lecture).

12th week: Decision-making and individual preferences (practice).

13th week: Cooperation: the use of game theoretical models in behavioural research (lecture and practice)

14th week: Consultation.

Requirements:

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can't make up any practice with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. In case of further absences, a medical certificate needs to be presented. Missed practice classes should be made up for at a later date, to be discussed with the tutor. Students are required to bring the drawing tasks and drawing instruments of the course to each practice class. Active participation is evaluated by the teacher in every class. If a student's behavior or conduct doesn't meet the requirements of active participation, the teacher may evaluate his/her participation as an absence because of the lack of active participation in class.

Students have to **submit all three lab reports** as scheduled minimum at a sufficient level. The average scores calculated from the three lab reports will produce the final practical grade. See grading table below.

The course ends in an **examination**. Exam grade is calculated based on the grading table below.

The minimum requirement for passing the examination and receiving an exam grade as well as a practical grade is 60%. The grade for the examination and the lab reports is given according to the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the score of any test is below 60, students can take a retake test in conformity with the EDUCATION AND EXAMINATION RULES AND REGULATIONS.

Person responsible for course: Dr. Zoltán Németh, PhD, assistant professor
Lecturers: Dr. Zoltán Németh, PhD, assistant professor, Prof. Dr. Tamás Székely, PhD, professor, Prof. Dr. Zoltán Barta, PhD, professor, Dr. Miklós Bán, assistant professor

Title of course: **Life history evolution seminar** **Code**: TTBML0340_EN	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: 0 hours/week - practice: 0 hours/week - laboratory: 3 hours/week	
Evaluation: exam	
Workload (estimated), divided into contact hours: - lecture: 0 hours - practice: 0 hours - laboratory: 42 - home assignment: 40 hours - preparation for the exam: 0 hours Total: 82 hours	
Year, semester: 2nd year, 1st semester	
Its prerequisite(s):	
Further courses built on it:	

Topics of course

The goal of the course is that students learn the basics of life history theory and its connections with other fields. Since life history evolution is responsible for a great part of biodiversity (throught the evolution of diverse life histories), it provides a good opportunity for students to strengthen their ability to analyse evolutionary patterns and relationships between different fields of biology and integrate their knowledge into a system-wide view.
Topics: Evolutionary patterns. Life history traits. The role of adaptation and constraints in life history evolution. Simple demographic models. Age-structured life populations, life tables. Reproductive value. The measurements of fitness components and their limitations. Basic quantitative genetics and reaction norms. Plasticity and consistency. The heritability of life history traits. The heritability of phenotypic plasticity. The integration of the plastic response. Trade-offs. Physiological, microevolutionary and macroevolutionary trade-offs, intra- and intergenerational trade-offs. Size at maturation and lifespan. The size and number of offspring. Reproductive lifespan and ageing. The evolutionary theories of ageing. Human life history.

Literature

Compulsory: course material

Recommended: Stephen C. Stearns. The Evolution of Life Histories. (1992). Oxford University Press.
Ricklefs R. Ageing: a natural history (1995). Scientific American Library.

Schedule:

1st week: The presentation of life-history theory and its connection with other fields of biology.

2nd week: Life history traits. Adaptation and constraints.

3rd week: Demography: age and stage structure. Life tables, The Euler–Lotka equation.

Calculating r. The stable age distribution. Generation time. Rates of increase

4th week: Reproductive value. Residual reproductive value and the costs of reproduction.

5th week: Quantitative genetics and reaction norms. Heritabilities of life history traits. Selection on quantitative traits.

6th week: Trade-offs. Concepts and types of trade-offs. Physiological trade-offs. Microevolutionary trade-offs: intra-individual and intergenerational

7th week: Lineage-specific effects

8th week: Age and size at maturity

9th week: Number and size of offspring

10th week: Reproductive lifespan and ageing. A phylogenetic perspective on lifespan.

11th week: Evolutionary theories of ageing and death.

12th week: Human life-histories.

13th week: Proximate regulators of life-histories.

Requirements:

- *for a signature*

Participation at the seminar is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course.

- *for a grade*

Students will be given home assignments regularly. In these assignments, students need to critically develop and apply the learned material to study problems related to life-history theory. Grades will be given based on the following table:

Score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

Person responsible for course: Dr. Adam Z Lendvai, associate professor, PhD

Lecturer: Dr. Adam Z Lendvai, associate professor, PhD

Title of course: **Conservation genetics** **Code**: TTBME0420_EN, TTBMG0420_EN	**ECTS Credit points: 1+2**

Type of teaching, contact hours
- lecture: 1 hour/week
- seminar: 2 hours/week
- laboratory: -

Evaluation: exam

Workload (estimated), divided into contact hours:
- lecture: 14 hours
- practice: 28 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 40 hours

Total: 112 hours

Year, semester: 2nd year, 2nd semester

Its prerequisite(s): -

Further courses built on it: -

Topics of course

The debate on the amount of variation in natural populations. The types of variation: phenotypic variation, chromosomal polymorphism, enzyme polymorphism, DNA techniques to study variation. Problems of small populations: the effect of inbreeding, inbreeding coefficient, inbreeding depression; the effect of genetic drift: loss of allele richness, bottle neck effect, founder effect. The forces forming the genetic structure of population systems: genetic differentiation, the indices of genetic differentiation (genetic distances and fixation index); migration, equilibrium between differentiation and migration, genetic consequences of isolation, models of migration. Habitat fragmentation. metapopulation structure.

Literature

Compulsory:
Franham, R., Ballou, J.D. and Briscoe, D.A. 2004. *A primer of conservation genetics*. Cambridge University Press

Recommended:

Schedule:

1st week: Debate on the level of variation in natural populations. Types of variation I: phenotypic variation,

2nd week: Types of variation II: chromosomal polymorphism, enzyme polymorphism.

3rd week: Types of variation III: Variation at the DNA level (A). Classic methods: RFLP, RAPD, AFLP.

4th week: Types of variation IV: Variation at the DNA level (B). New techniques: mini- and microsatellites, DNA sequencing. Nuclear DNA: SNP; mitochondrial DNA: phylogeography.

5th week: Evolutionary forces in small populations I. Inbreeding (A): Inbreeding and panmictic coefficients, genotypic changes in inbred populations, identical homozygotes.

6th week: Evolutionary forces in small populations II. Inbreeding (B): Inbreeding depression, the relationship between inbreeding and population size. The minimal size of viable populations.

7th week: Evolutionary forces in small populations III. Genetic drift (A): Random walk, allele fixation and loss of alleles, the erosion of variation. Relationship between population size and genetic drift.

8th week: Evolutionary forces in small populations IV. Genetic drift (B): Bottleneck effect, founder effect, the subpopulation structure within the populations.

9th week: Evolutionary processes in a population system I. Genetic differentiation (A): The background of genetic differentiation, differentiation and isolation.

10th week: Evolutionary processes in a population system II. Genetic differentiation (B): The measures of genetic differentiation. Geometric and genetic distances, fixation index, Wrght's F-statistics.

11th week: Evolutionary processes in a population system III. Migration: The genetic consequences of migration. Models of migration.

12th week: Habitat fragmentation. Metapopulation structure, models.

13th week: Selection in small populations. Adaptive and neutral variation.

14th week: Problems in nature conservation. Ex-situ and in situ nature conservation.

Requirements:

- *for a signature*

Attendance at **lectures** is recommended, but not compulsory.

Participation at **seminars** is compulsory. A student must attend the seminars and may not miss more than two times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. Attendance at seminars will be recorded by the leader.

Students have to **prepare presentation on selected subject** on a sufficient level.

In the end of the semester there is a test. Students have to sit for the tests

- *for a grade*

The course ends with a verbal **examination**.

Person responsible for course: Dr. Katalin Pecsenye, associate professor, PhD; Dr. Edit Juhász, assistant professor, PhD

Lecturer: Dr. Katalin Pecsenye, associate professor, PhD

Dr. Edit Juhász, assistant professor, PhD

Specialized courses for numerical biology

Course schedules and grade requirements will be posted by the instructors at the beginning of each semester.

Title of course: **Linux command line** **Code**: TTBML1400_EN	**ECTS Credit points: 4**
Type of teaching, contact hours - lecture: - - seminar: 3 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 42 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 112 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s): -	
Further courses built on it: Database management (TTBML1440_EN), Image processing (TTBMG1410_EN), Web tools (TTBMG1430_EN)	
Topics of course	
Aims: be able to work independently in a Linux environment, be able to solve text processing problems in a command line environment. Topics: Filesystem, Network, Pipe, Sed, Awk, Grep, Find, Bg, Fg, Top, Ps, Text processing, Regular expressions, Bash programming, basic Perl knowledge	
Literature	
Compulsory: *Recommended:* - Linux Server Hacks by Rob Flickenger. - Learning the bash Shell: Unix Shell Programming (In a Nutshell (O'Reilly)) Third Edition by Cameron Newham - Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, 2nd Edition by Mokhtar Ebrahim, Andrew Mallett - sed & awk Second Edition by Dale Dougherty, Arnold Robbins - Regular Expressions Cookbook: Detailed Solutions in Eight Programming Languages Second Edition by Jan Goyvaerts, Steven Levithan	
Person responsible for course: Dr. Miklós Bán, assistant professor, PhD	
Lecturer: Dr. Miklós Bán, assistant professor, PhD	

Title of course: **R programming** **Code**: TTBML1405_EN	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: - - seminar: 3 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 42 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 112 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s): -	
Further courses built on it: Biostatistics (TTBML1435_EN)	
Topics of course	
The basic steps of the R programming cycle. The structure of a R programs. Data and variables. Data types. Commands, loops. Functions. File management. Data structures. R packages.	
Literature	
Compulsory: *Recommended:* Garrett Grolemund & Hadley Wickham: R for Data Science Programming with R: http://swcarpentry.github.io/r-novice-inflammation/ R for Reproducible Scientific Analysis: https://swcarpentry.github.io/r-novice-gapminder/ An Introduction to R: W. N. Venables, D. M. Smith and the R Core Team R Markdown: The Definitive Guide, Yihui Xie, J. J. Allaire, Garrett Grolemund	
Person responsible for course: Dr. Zoltán Barta, professor, DSc	
Lecturers: Dr. Zoltán Barta, professor, DSc, Gergő Oláh, MSc	

Title of course: **Python programming** **Code**: TTBML1415_EN	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: - - seminar: 3 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 42 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 112 hours	
Year, semester: 1st year, 2nd semester	
Its prerequisite(s): -	
Further courses built on it: Machine learning (TTBML1450_EN), Genome assembly (TTBML1460_EN), Genome annotation (TTBML1465_EN), Transcriptomics (TTBML1470_EN)	
Topics of course	
The basic steps of the Python programming cycle. Error types: syntactic and semantic errors and how to handle them. The structure of a Python programs, structured programming. Data and variables. Data types. Commands, loops. Functions. File management. Data structures: strings, lists, dictionaries. Classes, objects, inheritance. Exception handling.	
Literature	
Compulsory: *Recommended:* Gérard Swinnen: Learn with python	
Person responsible for course: Kornél Ecsedi, MSc	
Lecturer: Kornél Ecsedi, MSc	

Title of course: Database management Code: TTBML1440_EN	ECTS Credit points: 4

Type of teaching, contact hours
- lecture: -
- seminar: 3 hours/week
- laboratory: -

Evaluation: midsemester grade

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 42 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 40 hours

Total: 112 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): Linux command line (TTBML1400_EN)

Further courses built on it:

Topics of course

SQL basics
PostgresSQL database management system
Database client applications: Linux command line, R, Perl, QGIS, Web applications (Adminer, PhpPgadmin,..)
Managing biological databases

Literature

Compulsory:

Recommended:
- PostgreSQL Notes for Professionals
- Pavel Luzanov, Egor Rogov, Igor Levshin, PostgreSQL for beginners

Person responsible for course: Dr. Miklós Bán, assistant professor, PhD

Lecturer: Dr. Miklós Bán, assistant professor, PhD

Title of course: **Biostatistics** **Code**: TTBML1435_EN	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: - - seminar: 3 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 42 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 112 hours	
Year, semester: 2nd year, 1st semester	
Its prerequisite(s): R programming (TTBML1405_EN)	
Further courses built on it:	
Topics of course	
Introduction to the R statistical environment. Basic concepts of data management. Descriptive statistics. Statistical hypothesis testing. Statistical tests for means. Nonparametric tests. Statistical tests for variance and distributions. Analysis of variance. Evaluating association between continuous variables. Linear regression and correlation calculation. Analysis of covariance. Multivariate statistical models. Model selection procedures. Use conditions of linear statistical models. Generalised linear models. Linear mixed models. Principal component analysis.	
Literature	
Compulsory: *Recommended:* - Sokal RR. & Rohlf FJ. 1981. Biometry. W.H. Freeman, New York. - McElreath, Richard. Statistical Rethinking: A Bayesian Course with Examples in R and Stan. 2nd ed. CRC Texts in Statistical Science. Boca Raton: Taylor and Francis, CRC Press, 2020.	
Person responsible for course: Dr. Zoltán Barta, professor, DSc	
Lecturers: Dr. Zoltán Barta, professor, DSc,	

Title of course: **Machine learning** **Code**: TTBML1450_EN	**ECTS Credit points: 2**

Type of teaching, contact hours

- lecture: -
- seminar: 2 hours/week
- laboratory: -

Evaluation: midsemester grade

Workload (estimated), divided into contact hours:

- lecture: -
- practice: 28 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 40 hours

Total: 100 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s): Python programming (TTBML1415_EN)

Further courses built on it:

Topics of course

The goals of this course are to get familiar with the most important tasks, tools and techniques in machine learning. The subject focuses on solving realistic problems, to directly apply the basic concepts and results. The most important topics are exploiting useful information from a large amount of data for automatic classification and recognition purposes. Students will be exposed to the basic supervised techincs, such as regression models, trees, Bayes classifiers and neural networks. The course will highly rely on the python programming language. By the end of the course, the students will be able to design a machine learning model on a costume dataset.

Literature

Compulsory:

Francios Chollet, 2018. Deep Learning with Python, Manning Publications Co.

Aurélien Géron, 2019. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, Inc.

Recommended:

Person responsible for course: Attila Barta, MSc

Lecturers: Attila Barta, MSc

Title of course: **Introduction to bioinformatics** **Code**: TTBML1455_EN	**ECTS Credit points: 3**
Type of teaching, contact hours - lecture: - - seminar: 2 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 28 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 100 hours	
Year, semester: 1st year, 1st semester	
Its prerequisite(s):	
Further courses built on it:	
Topics of course	
The aim of this course is to introduce the multidisciplinary usage of bioinformatics in biological sciences. Students will learn about the history of bioinformatics, the origin of sequencing data, the types of data files and the most frequently used softwares in handling these files. In addition to the theoretical information, the educational material will be completed with practical tasks to deepen the knowledge of the students. By the end of the course, students will be able to recognise and identify the origin of the different files, search for similar sequences in databases and design primers for experiments on target sequences.	
Literature	
Compulsory: *Recommended:* - Samuelsson, T. (2012): Genomics and Bioinformatics: An Introduction to Programming Tools for Life Scientists. Cambridge University Press, Cambridge. - Selzer, P. M., Marhöfer, R. J. & Koch, O. (2018): Applied Bioinformatics – An Introduction. Springer Cham. - Lesk, A. M. (2019): Introduction to Bioinformatics. Oxford University Press, Oxford.	
Person responsible for course: Dr. Nikoletta Nagy, assistant professor, PhD	
Lecturers: Dr. Nikoletta Nagy, assistant professor, PhD	

Title of course: **Genome assembly** **Code**: TTBML1460_EN	**ECTS Credit points: 4**

Type of teaching, contact hours
- lecture: -
- seminar: 3 hours/week
- laboratory: -

Evaluation: midsemester grade

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 42 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 40 hours

Total: 112 hours

Year, semester: 2nd year, 1st semester

Its prerequisite(s): Python programming (TTBML1415_EN)

Further courses built on it:

Topics of course

During the course, students will be provided an overview of genome sequencing approaches and most importantly current approaches to data analysis of second and third generation sequencing data. The lectures will introduce students to openly available command line tools used for the effective processing of genomic data. The knowledge to acquired includes the quality control and filtering of sequencing data, different methodologies to assemble whole genome sequences and the assessment of reference genome quality and completeness. By the end of the course students will be able to recognize to importance of genome sequencing and assembly, and will be able to design and carry out experiments using genome sequencing data.

Literature

Compulsory:
- Mount, D. W. (2004). Bioinformatics: Sequence and genome analysis (2nd ed). Cold Spring Harbor Laboratory Press.

Recommended:
- Brown, T. A. (Ed.). (2002). Genomes (2nd ed). Wiley-Liss.
- Masoudi-Nejad, A., Narimani, Z., & Hosseinkhan, N. (2013). Next generation sequencing and sequence assembly: Methodologies and algorithms. Springer.

Person responsible for course: Dr. Levente Laczkó, PhD

Lecturers: Dr. Levente Laczkó, PhD; Dr. Nikoletta Nagy, assistant professor, PhD

Title of course: **Genome annotation** **Code**: TTBML1465_EN	**ECTS Credit points: 4**
Type of teaching, contact hours - lecture: - - seminar: 3 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 42 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 112 hours	
Year, semester: 2nd year, 2nd semester	
Its prerequisite(s): Pythone programming (TTBML1415_EN)	
Further courses built on it:	
Topics of course	
The students will be provided an overview of genome annotation approaches, the analysis of genomic content and the comparison of genes and genomes. The lectures will rely on tools used frequently by the scientific community to find and annotate genomic features using ab initio and evidence-based prediction. By the end of the course students will be able to recognize to importance of genome annotation and will be able to evaluate genomic content, including the large scale comparison of genomes using comparative genomics and pangenomic methods	
Literature	
Compulsory: - Soh, J., Gordon, P. M. K., & Sensen, C. W. (2013). Genome annotation. CRC Press, Taylor & Francis Group. *Recommended:* - Koonin, E. V., & Galperin, M. Y. (2003). Sequence - Evolution - Function: Computational Approaches in Comparative Genomics. Kluwer Academic. - Setubal, J. C., Stoye, J., & Stadler, P. F. (Eds.). (2018). Comparative genomics: Methods and protocols. Humana Press.	
Person responsible for course: Dr. Levente Laczkó, PhD	
Lecturers: Dr. Levente Laczkó, PhD; Dr. Nikoletta Nagy, assistant professor, PhD	

Title of course: **Transcriptomics** **Code**: TTBML1470_EN	**ECTS Credit points: 4**
Type of teaching, contact hours - lecture: - - seminar: 3 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 42 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 112 hours	
Year, semester: 2nd year, 2nd semester	
Its prerequisite(s): Python programming (TTBML1415_EN)	
Further courses built on it:	
Topics of course	
The goals of this course are (1) to provide an overview of the usage of RNA-sequencing data and (2) to introduce the different steps and methods in transcriptome analysis. During the classes, students will become acquainted to handle the sequencing data, performing de novo or reference-based transcriptome assembly based on the available data, investigating the expression patterns of genes in different experimental conditions as well as predicting the functions of the genes of interest. By the end of the course, students will be able to filter and decontaminate the sequencing data, assemble the whole transcriptome of different model and non-model organisms, carry out differential gene expression analysis and provide functional information about genes.	
Literature	
Compulsory: *Recommended:* - Raghavan, V., Kraft, L., Mesny, F., & Rigerte, L. (2022). A simple guide to de novo transcriptome assembly and annotation. Briefings in Bioinformatics, 23(2), bbab563. - Wang, Y. & Sun M. (2018): Transcriptome Data Analysis – Methods and Protocols. Humana Press, New York. - Wu, J. (2016): Transcriptomics and Gene Regulation. Springer Dordrecht, Dordrecht.	
Person responsible for course: Dr. Nikoletta Nagy, assistant professor, PhD	
Lecturers: Dr. Nikoletta Nagy, assistant professor, PhD	

Title of course: **Image processing** **Code**: TTBMG1410_EN	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: -
- seminar: 1 hours/week
- laboratory: -

Evaluation: midsemester grade

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 14 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 40 hours

Total: 84 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): Linux command line (TTBML1400_EN)

Further courses built on it:

Topics of course

The course aims to enable students to learn the repeatable methods of image and video processing used in scientific research.
Course content, topics:
Automatisation using command-line tools: ImageMagick, VLC, Mplayer, ImageJ, ffmpeg
Getting to know video processing software: Mwrap, Tractor, Boris, idTracker

Literature

Compulsory:
Recommended:
- The Definitive Guide to ImageMagick, Michael Still
- Image Processing with ImageJ - Second Edition 2nd Edition by Jurjen Broeke, Jose Maria Mateos Perez, Javier Pascau

Person responsible for course: Dr. Miklós Bán, assistant professor, PhD

Lecturers: Dr. Miklós Bán, assistant professor, PhD

Title of course: **Web tools** **Code**: TTBMG1430_EN	**ECTS Credit points: 1**

Type of teaching, contact hours
- lecture: -
- seminar: 1 hours/week
- laboratory: -

Evaluation: midsemester grade

Workload (estimated), divided into contact hours:
- lecture: -
- practice: 14 hours
- laboratory: -
- home assignment: 30 hours
- preparation for the exam: 40 hours

Total: 84 hours

Year, semester: 1st year, 2nd semester

Its prerequisite(s): Linux command line (TTBML1400_EN)

Further courses built on it:

Topics of course

The course aims to enable students to
- get to know the web techniques necessary for scientific work
- be able use WEB APIs
- get to know web research tools

Course content, topics:
- Operation of the web
- APIs
- OpenBioMaps

Literature

Compulsory:

Recommended:
- Computer Networking: A Top-Down Approach 7th Edition (James Kurose, Keith Ross)
- HTTP: The Definitive Guide by David Gourley, Brian Totty, Marjorie Sayer, Anshu Aggarwal, Sailu Reddy, Released September 2002 Publisher(s): O'Reilly Media, Inc. ISBN: 9781565925090
- JSON at Work: Practical Data Integration for the Web 1st Edition (Tom Marrs)
- Introduction to JavaScript Object Notation (Lindsay Bassett)

Person responsible for course: Dr. Miklós Bán, assistant professor, PhD

Lecturers: Dr. Miklós Bán, assistant professor, PhD

Title of course: Geoinformatics Code: TTBML1425_EN	ECTS Credit points: 2
Type of teaching, contact hours - lecture: - - seminar: 2 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 28 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 98 hours	
Year, semester: 1st year, 2nd semester	
Its prerequisite(s):	
Further courses built on it:	
Topics of course	
The course aims to enable students to - be able to collect data with GPS devices - be able to display, transform and analyse geoinformatics data - be able to use QGIS - gain experience in using fundamental R packages for geoinformatics Course content, topics: The use of GPS devices: from handheld GPS to super precise devices – field practice Aerial photographs: raster analysis, aerial photography vs orthophoto: drone flight and the use of drone data in practice and theory QGIS: - R for geoinformatics - Databases and geoinformatics - Distribution modeling - Web applications for geoinformatics	
Literature	
Compulsory: *Recommended:* - Mayra Zurbaran et al., PostGIS Cookbook - Second Edition - https://www.rspatial.org/ - Open the Door to GIS: Student and Teacher Edition by Toni Fisher	
Person responsible for course: Dr. Miklós Bán, assistant professor, PhD	
Lecturers: Dr. Miklós Bán, assistant professor, PhD; Dr. Gergely Szabó, assistant professor, PhD	

Title of course: **Phylogenomics** **Code**: TTBML1475_EN	**ECTS Credit points: 2**
Type of teaching, contact hours - lecture: - - seminar: 2 hours/week - laboratory: -	
Evaluation: midsemester grade	
Workload (estimated), divided into contact hours: - lecture: - - practice: 28 hours - laboratory: - - home assignment: 30 hours - preparation for the exam: 40 hours Total: 98 hours	
Year, semester: 1st year, 2nd semester	
Its prerequisite(s):	
Further courses built on it:	
Topics of course	
The main goal of the course is to teach the basic principles of molecular phylogenetics with the main idea that phylogenomics is phylogenetics used at the genomic level. Therefore, a general overview of molecular phylogenetics is given with the basics of phylogenetic work (assessment of homology, the role of characters in evolutionary systematics, basic cladistics) and an overview of phylogenetic techniques (DNA fingerprinting and DNA-sequencing) and phylogenetic tree reconstruction methods. Here, we put an emphasis on the use of genomic approaches and their characteristics compared to classical phylogenetic methods. Finally, we will overview the different phylogenomic approaches including organellar phylogenomics, genome skimming and re-sequencing, various reduced-representation library approaches, and RNA-seq. By the end of the course, the students will have a general overview of the available phylogenomic research approaches and toolkits, so they will be able to design their project tailored to their research question.	
Literature	
Compulsory: Hohenlohe, P. A., Hand, B. K., Andrews, K. R. & Luikart, G. in Population Genomics: Concepts, Approaches and Applications (ed Om P. Rajora) 483-510 (Springer International Publishing, 2019). doi: 10.1007/13836_2018_20 *Recommended:* - Glenn–Peter Sætre & Mark Ravinet (2019) Evolutionary Genetics: Concepts, Analysis, and Practice. Oxford: Oxford University Press. ISBN: 9780198830917 - Allendorf, F. W., Funk, W. C., Aitken, S. N., Byren, M., Luikart, G. (2022) Conservation and the Genomics of Populations. Oxford: Oxford University Press. isbn: 9780198856566	
Person responsible for course: Dr. Gábor Sramkó, assistant professor, PhD	
Lecturers: Dr. Gábor Sramkó, assistant professor, PhD	